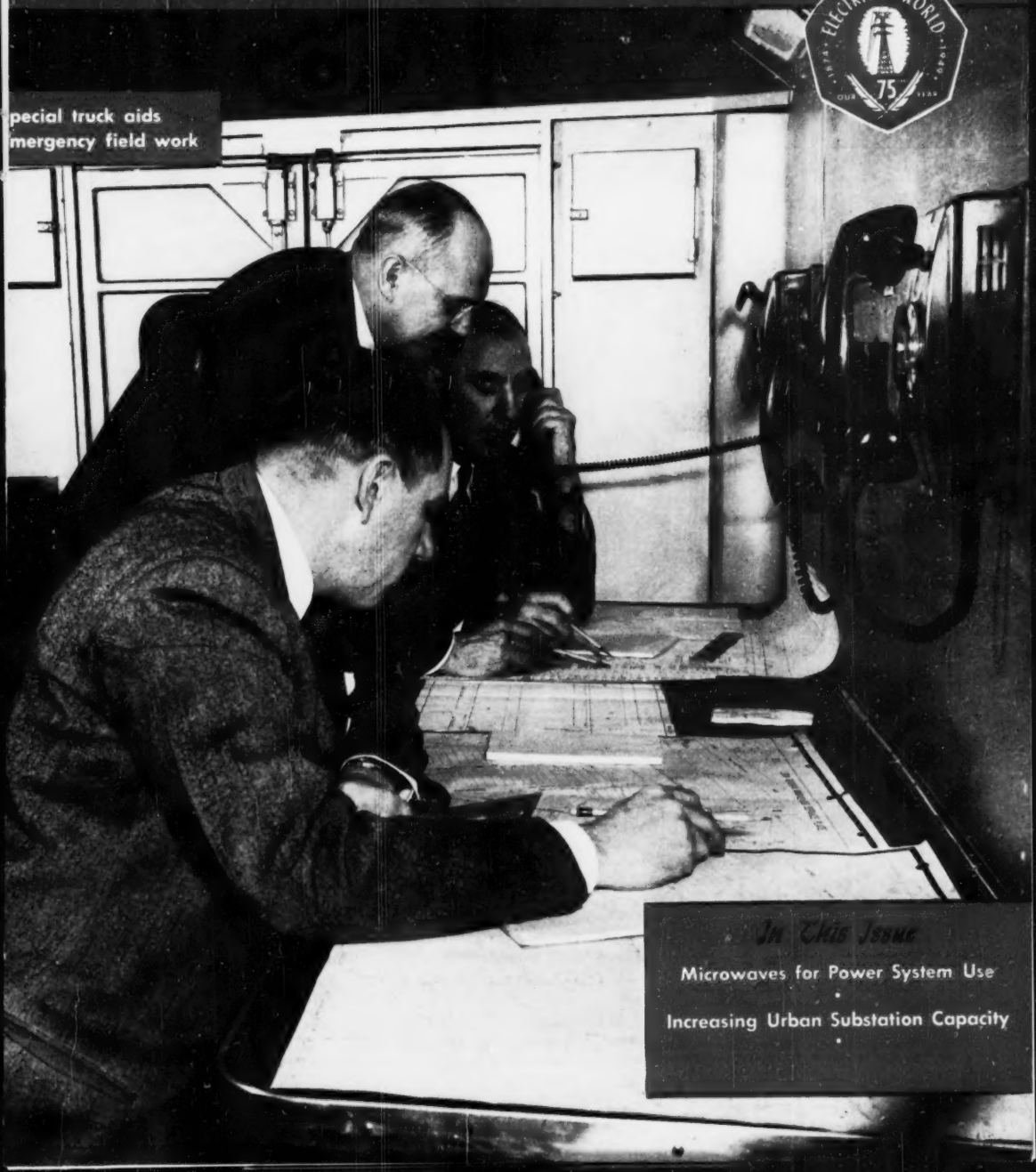
ELECTRICAL WORLD

A McGRAW-HILL PUBLICATION

JULY 16, 1949



In This Issue

Microwaves for Power System Use

Increasing Urban Substation Capacity

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WESTON A-C Clamp-Ammeter and VOLTMETER

5 Current ranges to 1000 Amperes

3 Voltage ranges to 700 Volts

Voltage terminals recessed, with insulated screw-type connectors on leads.

Heavily insulated jaws accommodate conductors to 2" dia. (bare or insulated).

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ELECTRICAL WORLD

Published for 75 years for those engaged in the business of generating, transmitting, distributing or applying electric power

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A STORY IN TWO PARTS . . . PART 1*

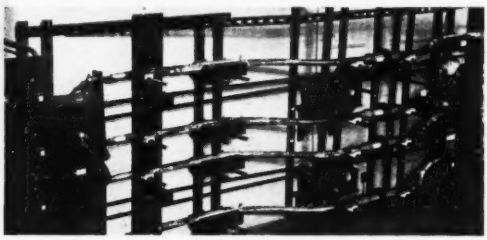
HOW OKOMETAL of reduced thickness PLUS OKOSHEATH Protective Covering

...provides 6 major advantages to paper cable users

*** A story so important that it will be developed in two successive issues of this magazine.**

Okometal of reduced thickness plus Okosheath Protective Covering is the latest improvement in paper cable sheathing produced by Okonite-Callender Research Laboratories. The result of long, intensive study and testing, it is a composite sheath of alloyed lead protected by a tough, reinforced neoprene covering vulcanized and firmly bonded to the lead. This dual sheath provides *six major advantages* to a growing list of users. Here are three of the advantages you get with Okometal-Okosheath cable construction:

Doubled Cable Life Expectancy: Dummy manhole-bending machine tests show that Okometal — a lead alloy developed by the Okonite-Callender Research Laboratories — doubles service life expectancy through increased resistance to bending fatigue at joint offsets in manholes. This doubled resistance permits the use of reduced lead thicknesses up to one-third less than standard when the Okosheath Protective Covering is employed.



DUMMY MANHOLE TEST: Completed cables with joints, trained to standard contours are subjected to ½" movement at 4-minute cycles at actual operating temperatures. In this, and similar power company tests, 270 bending cycles are equal to about 1 year actual service. Cables with Okometal-Okosheath Protective Covering outlast plain lead-covered cables 2½ to 1.

Elimination of Corrosion: For over 15 years our Okosheath Protective Covering has been used by power companies to eliminate chemical, electrolytic and galvanic corrosion of lead sheaths. There is no recorded instance where lead sheath corrosion has occurred in cables protected by Okosheath. Extensive laboratory, field and service tests yield convincing evidence of its complete resistance to corrosion.

Reduced Installation and Maintenance Costs: In addition to reducing the number of manholes and joints through lighter weight and a lower co-efficient of friction, this Okometal-Okosheath combination promotes further economies through eliminating the costly practice of grading and flushing duct lines. Longer cable life and doubled resistance to failure also contribute to reduced maintenance costs.

• • •

In the next issue of this magazine we will discuss these remaining important advantages of Okometal-Okosheath cable construction:

GREATER BURSTING STRENGTH • PREVENTION OF LEAD SCORING
EASIER PULLING

Meanwhile, comparative test results, explanatory photographs and diagrams, as well as more detailed information of this important development are available in Research Publication 110. Write for your copy on your business letterhead. The Okonite Company, Passaic, N. J.

Compare this substantial dual construction with plain lead of same core diameter.

Okonite-Callender cables with this composite sheath meet *all* AEIC Test requirements for paper cables with plain lead of standard thickness.

7633

OKONITE-CALLENDER paper insulated power cables

SAVE TIME *and* TROUBLE

with *Electroline* products for

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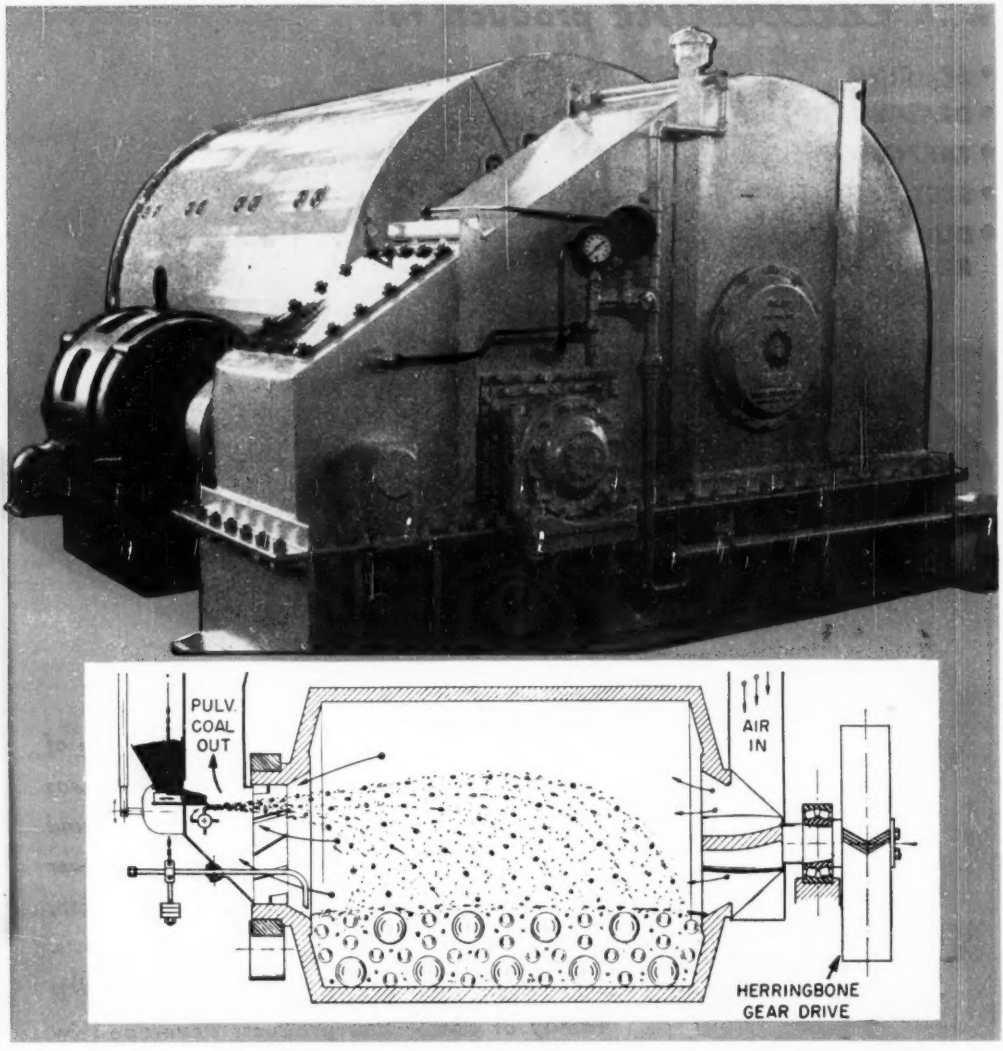

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LOWEST MAINTENANCE. Maintenance of the Riley Ball Tube Mill is extremely low consisting almost entirely of maintaining the ball charge and an occasional replacement of exhauster fan blades. All major parts of equipment—liners, gears, etc.—have a normal life of over ten years.

LOW POWER CONSUMPTION. Power consumption with the Riley Ball Tube Mill is from 10% to 20% lower than with ordinary mills of this type and at or near full capacity, power consumption is lower than with many other types of pulverizers. Low operating power results from the use of a three point suspension system in self-aligning anti-friction bearings, high efficiency herringbone gear reducer drive and the method of feeding coal and air to the pulverizer. An automatic type clutch coupling between pulverizer and drive motor permits the use of standard constant speed, normal torque high efficiency type drive motor.

ABILITY TO HANDLE HIGH MOISTURE COALS. The Riley Ball Tube Mill will handle high moisture coals with but little reduction in capacity. The high capacity reduction with increased moisture of the ordinary ball tube mill does not occur because coal is fed in suspension permitting effective drying in a counterflowing preheated air stream of automatically controlled temperature to meet prevailing drying requirement. Since coal is spread over full pulverizer length and not concentrated at one end of pulverizer, the tendency of coal to cake is minimized.

SMALLER IN SIZE AND WEIGHT. By using all steel construction, the over-all size and weight is materially reduced. Counterflow of air and coal, and the unique method of distributing coal uniformly over the full length of the pulverizer, thus providing uniform feed to a uniform ball charge thereby making full use of all grinding elements, result in a greater coal pulverizing capacity for a given size of mill. Riley Ball Tube Mills can consequently be installed where space is restricted. Smaller foundations are also required.

The New Riley Ball Tube Mill together with the improved Riley Atrita Pulverizer, (now available with tungsten carbide wearing parts and other new developments), enables Riley to most effectively meet the requirements of all conditions involving the use of pulverized coal.

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NEW APPLICATION "POINTERS"...
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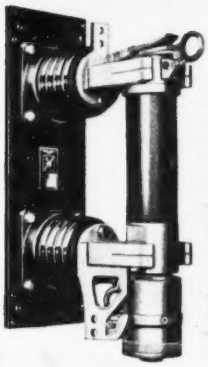
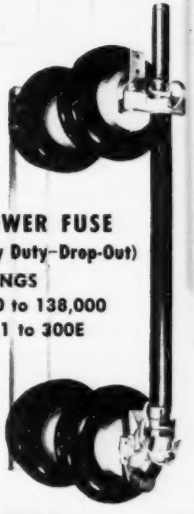


SM POWER FUSE
(Boric Acid—Heavy Duty)
RATINGS
Volts: 7500 to 34,500
Amperes: ½ to 800E

LIQUID POWER FUSE
RATINGS
Volts: 7500 to 138,000
Amperes: ½ to 250E

HSO POWER FUSE
(Boric Acid—Drop-Out)
RATINGS
Volts: 7500 to 69,000
Amperes: 1 to 200E



SMD-2 POWER FUSE
(Boric Acid-Heavy Duty-Drop-Out)
RATINGS
Volts: 34,500 to 138,000
Amperes: 1 to 300E

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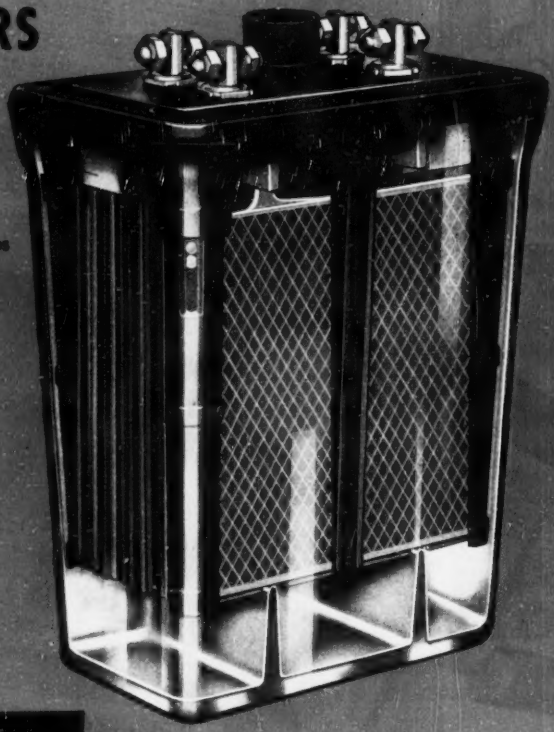

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You have to split the outer covering and trim it off. Then rip off the filler if it doesn't come away clean. Spread the wires apart and u-n-w-i-n-d the kraft paper wrap from one, then u-n-w-i-n-d the paper wrap from the other.

The New TRIEX Way

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SUBSIDIARY OF NOMA ELECTRIC CORPORATION

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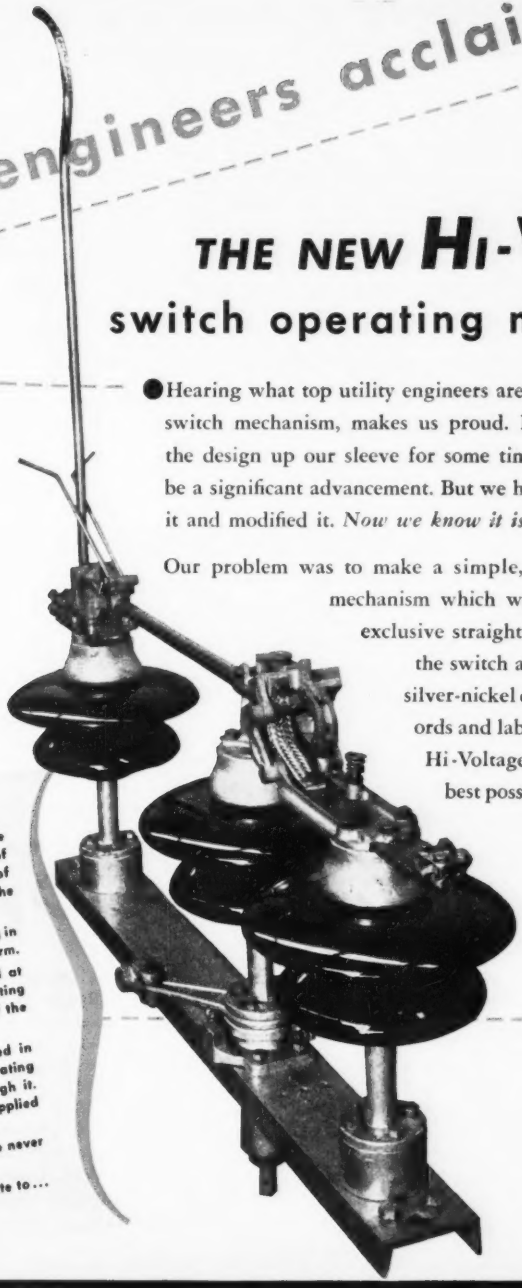
Our problem was to make a simple, foolproof actuating mechanism which would still develop the exclusive straight-line, in-out motion of the switch arm into and out of the silver-nickel contacts. Operating records and laboratory tests prove this Hi-Voltage operating cycle is the best possible method of contact.



This simple linkage produces the straight-line horizontal motion of the switch arm into and out of contact, and raises the arm to the vertical position.

There is no lost motion, resulting in positive control of the switch arm.

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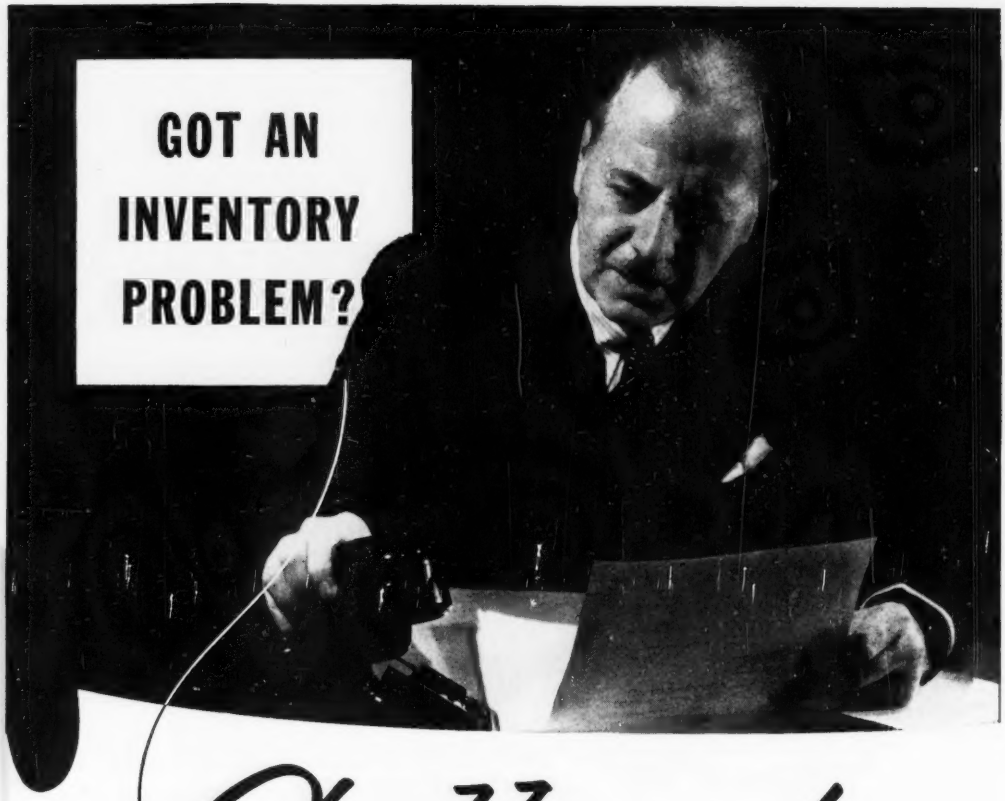

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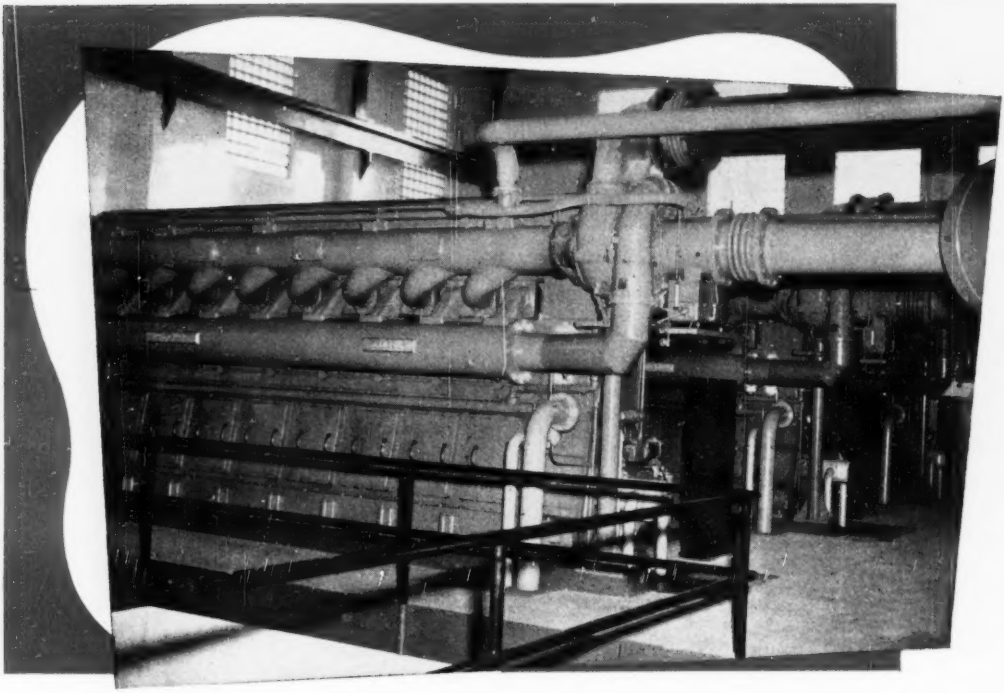
SERVING INDUSTRY... WHICH SERVES MANKIND



This is the way a dream came true

For 50 years officials of a Michigan town planned and worked to secure an adequate source of electrical power.

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APPLETON DISKONECT REFLECTORS

Pat. No. 1,993,385

the most practical DETACHABLE REFLECTORS *ever made!*

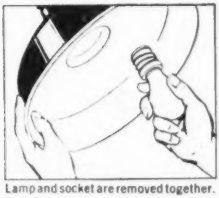
Here's Appleton's answer to the ever-present problem of installing and servicing light reflectors quickly and easily. The Diskonect Reflector is attached or detached from the hood instantly by means of a snap lock—without twisting, tugging, forcing or the use of tools. The heavy drawn-steel hood is fitted with a spring-set lever which locks or unlocks the porcelain enameled reflector.

Even when the Diskonect Reflector remains in place for extended periods, detachment remains quick and easy. Corrosion and "freezing" together of component parts are prevented by metal-to-glass connection—heavy, rustless cadmium plate to porcelain enamel.

Diskonect Reflectors are finished in permanent porcelain enamel and offered in a wide variety of styles. Complete "come-apart" construction permits cleansing of all parts separately a time-saving feature that enables you to maintain a higher standard of lighting efficiency. Write for catalogue information.

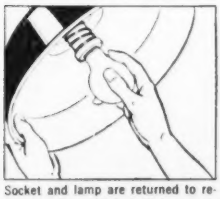
5 SIMPLE STEPS FOR EASIER SERVICING

Release spring-set lever. Reflector and lamp are detached instantly, as a unit.

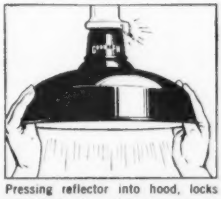


Lamp and socket are removed together. Slight upward pressure and a quarter turn remove them from reflector.

Reflector may be immersed in water for thorough cleaning to restore original reflecting surfaces.



Socket and lamp are returned to reflector and securely locked with merely a simple twist of the wrist.



Pressing reflector into hood, locks reflector in place, lights lamp, again delivers full illuminating efficiency.

SOLD THROUGH ELECTRICAL WHOLESALERS

APPLETON ELECTRIC COMPANY

1705 WELLINGTON AVENUE • CHICAGO 13, ILLINOIS

Branch Offices: NEW YORK, 50 Church St. • DETROIT, 3049 E. Grand Blvd. • CLEVELAND, 1836 Euclid Avenue • SAN FRANCISCO, 655 Minna St. • ST. LOUIS, 420 Frisco Bldg. • LOS ANGELES, 100 N. Santa Fe Avenue • ATLANTA, 724 Boulevard, N.E. • BIRMINGHAM, 429 Brown-Marx Bldg. • MINNEAPOLIS, 305 Fifth St., S. • PITTSBURGH, 414 Bessemer Bldg. • BALTIMORE, 100 East Pleasant, St. • BOSTON, 10 High Street • DENVER, 1921 Blake Street • PHILADELPHIA, 1017 Cherry Street.

•

Resident Representatives: Cincinnati, Dallas, Houston, Indianapolis, Kansas City, Milwaukee, Seattle

Export Representatives: International Standard Electric Corp., 67 Broad St., New York 4, N. Y.

APPLETON ELECTRIC PRODUCTS

APPLETON

CONDUIT FITTINGS • LIGHTING EQUIPMENT • OUTLET AND SWITCH BOXES • EXPLOSION-PROOF FITTINGS • REELITES

IRV-O-SLOT

The slot insulation *Bound* to last longer

The big news about Irv-O-Slot is good news for motor manufacturers. This famous slot insulation, with all its excellent electrical characteristics, benefits by a new, specially-developed Irvington binder that doesn't harden or lose its tack; that provides full assurance against migration . . . against delamination . . . against oozing out under heat. Thus Irv-O-Slot provides far greater service life, and far longer shelf life as well; and the thickness of the finished insulation is held within exact tolerance limits.

Test Data: **The normal delamination test for slot insulation is 96 hours at 125°C. Laboratory tests show Irv-O-Slot withstands 150°C. for over 288 hours, retaining full bond without migration.**

Irv-O-Slot is available in straight-cut or seamless bias varnished cambric bonded to either fish paper or rag stock. Write for generous test samples, further information.

New IRVINGTON Binder provides an insulation that

Won't Migrate!
Won't Delaminate!

"Look to Irvington **for Continued Leadership in Insulation"**

IRVINGTON *Varnish & Insulator Company*

Irvington 11, New Jersey

Authorized distributors in Atlanta; Baltimore; Berkeley; Bluefield, W. Va.; Boston; Charlotte; Chicago; Cleveland; Dallas; Denver; Detroit; Los Angeles; Milwaukee; Minneapolis; New Hartford, N.Y.; New Orleans; Philadelphia; Pittsburgh; Portland, Ore.; St. Louis; Seattle; Hamilton, Ont., Canada.

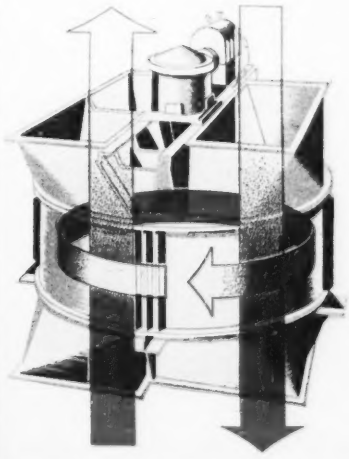
Fact File on Preheat

No. 3

The regenerative principle of heat exchange favors a high ratio of effective surface area to unit volume. In the Ljungstrom, this is accomplished by a compact arrangement of heat-transfer elements.

All the characteristics of the Ljungstrom's rotating heat-transfer unit—its surface area, size and shape of passages, and counter-flow arrangement—act to obtain maximum heat recovery for the unit's size and weight.

LJUNGSTROM



The Ljungstrom Air Preheater is a compact gas-to-air or gas-to-gas heat exchanger, operating on a continuous regenerative counterflow basis. Hundreds of leading power plants and other special applications confirm its high level of heat recovery and long-term low maintenance service.

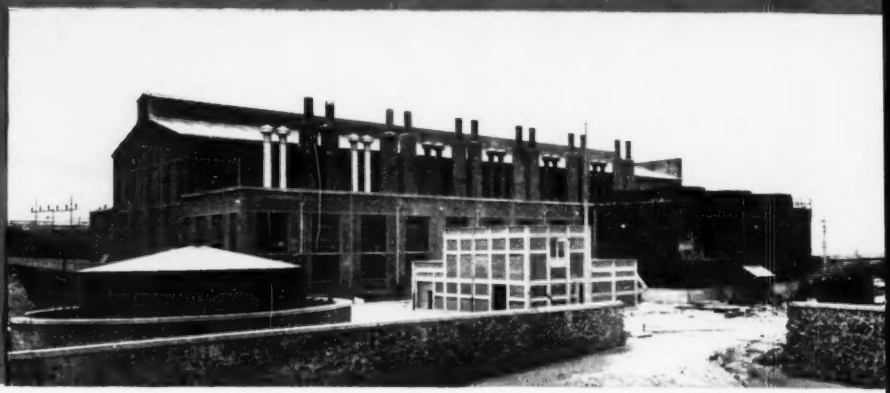
THE

AIR PREHEATER CORPORATION

60 EAST 42ND STREET · NEW YORK 17, N. Y.

Plant: Wellsville, N. Y. 1284

WORLD'S LARGEST DIESEL



The new Tacubaya generating station houses the six Nordberg Diesels and auxiliaries.

THE installation of six 8,650 horsepower engines in the new Tacubaya generating station in Mexico City establishes another record for Nordberg Diesels. In addition to being the world's largest Diesel powered public utility generating station, these engines are the largest ever built in the Western Hemisphere. These six engines have a total capacity of 51,900 H. P. at sea level or 44,400 H. P. at the installed elevation of 7,450 feet. This new plant, adding 30,000 K. W. for the power and lighting needs of Mexico City, was in service months sooner than was possible with any other type of power unit and is helping to alleviate a serious power shortage that had developed because of the increased demands for electric service.

Nordberg Diesels have long been recognized for their reliable and economical performance. Nordberg is proud of having supplied the engines and assisted the Compania Mexicana de Luz Y Fuerza, S. A. and the Comision Federal de Electricidad in the design of this mammoth public utility.

NORDBERG MFG. CO.
MILWAUKEE 7, WISCONSIN

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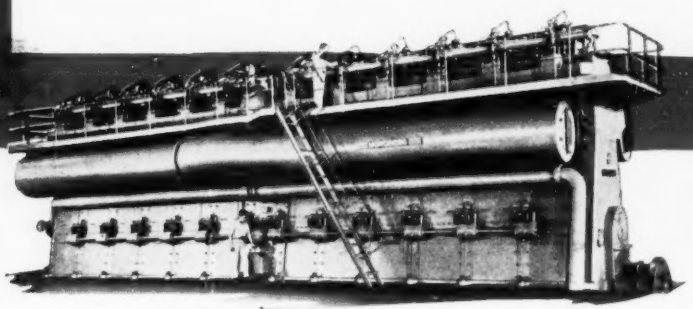
P749



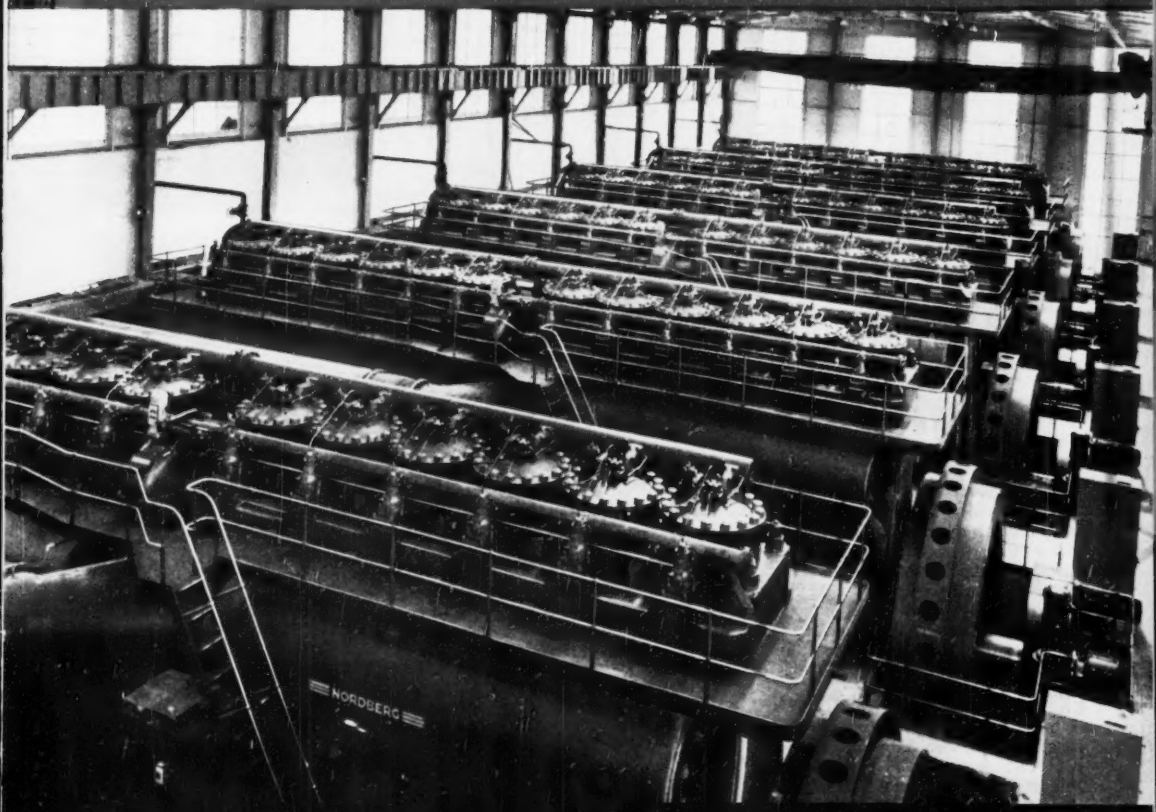
One of the six Nordberg Diesels installed at Tacubaya. In addition to these 8,650 H.P. units, Nordberg also builds an extensive line of Diesel and gas burning engines in two and four-cycle types for stationary and marine service from 10 H. P. up.

ELECTRIC PUBLIC UTILITY

powered with

SIX 8650 H. P. NORDBERG DIESELS

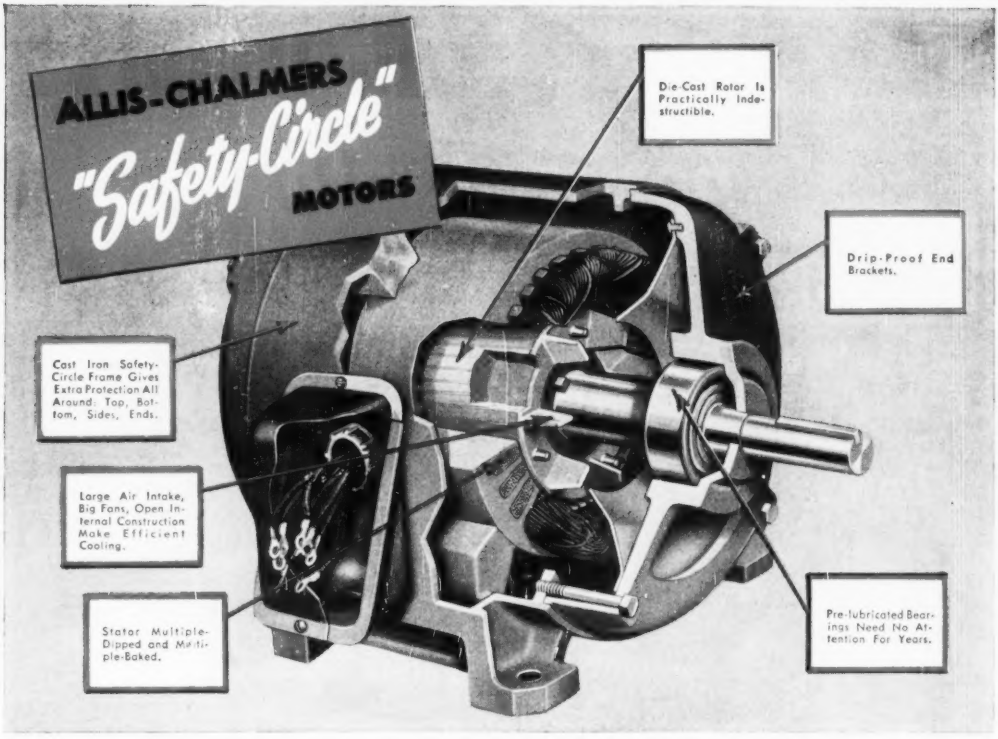
. . . On The Line 20 Months From Date Of Order



A DIVISION OF NORDBERG

NORDBERG

DIESEL ENGINES


ALLIS-CHALMERS
"Safety-Circle"
MOTORS
Die-Cast Rotor Is Practically Indestructible.
Drip-Proof End Brackets.
Cast Iron Safety-Circle Frame Gives Extra Protection All Around. Top, Bottom, Sides, Ends.
Large Air Intake, Big Fans, Open Internal Construction Make Efficient Cooling.
Stator Multiple-Dipped and Multiple-Baked.
Pre-lubricated Bearings Need No Attention For Years.

HOW SAFETY-CIRCLE

Means Motor Dependability

EXTRA PROTECTION means extra dependability. That's why Allis-Chalmers protects the working parts of the motor with the exclusive SAFETY-CIRCLE. Compare this motor with motors of less rigid construction. The SAFETY-CIRCLE motor will not distort in mounting or under strain. And you get the extra protection of drip-proof end brackets at no premium.

EXTRA PROTECTION INSIDE, TOO

Stator is multiple-dipped and multiple-baked in special insulating varnish. Rotor is die-cast aluminum. Stator is mounted in four longitudinal ribs which leaves plenty of air space between stator and frame. Large fans cast integrally with the rotor and ample air intakes keep temperatures well within rated limits. *Ball bearings are factory-lubricated and require no further attention for years.*

When you shop for motors, remember SAFETY-CIRCLE gives you *extra protection, extra dependability* and *lower operating costs.*

For details on SAFETY-CIRCLE advantages, see your A-C Authorized Dealer or Sales Office or write for Bulletin 51B6210B. Sizes 1 to 20 hp, 326 frames and smaller. *Safety-Circle, Texrope* and *Vari-Pitch* are Allis-Chalmers trademarks.

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Applied . . .
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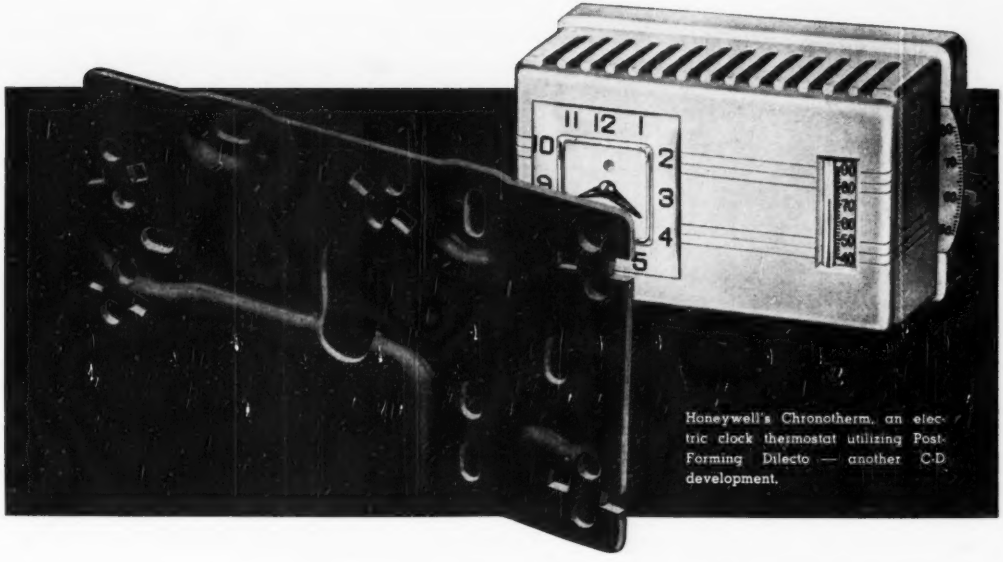
CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

TEXROPE — Belts in all sizes and sections, standard and Vari-Pitch sheaves, speed changers.

PUMPS — Integral motor and coupled types. Sizes and ratings to 2500 GPM.

another C-D development . . .

an unusual material that can change your ideas about molding plastics!



Honeywell's Chronotherm, an electric clock thermostat utilizing Post-Forming Dilecto — another C-D development.

From Continental-Diamond laboratories comes a different plastic that makes parts production faster, easier, and more economical! Post-Forming Dilecto can be formed at a temperature of only 300°F and 200 lbs. pressure. It faithfully retains the shape you give it—eliminates the need for molding many different shapes. Expensive molding dies are no longer necessary. Available in sheet form or finished parts.

Post-Forming Dilecto is another reason why it pays to see C-D first in your search for the right plastic. For C-D Plastics provide *practical* combinations of mechanical, electrical, and chemical properties—structural strength, light weight, moisture, heat and corrosion resistance. For fast delivery or additional information, call your nearest C-D office, now.

DE-4-49

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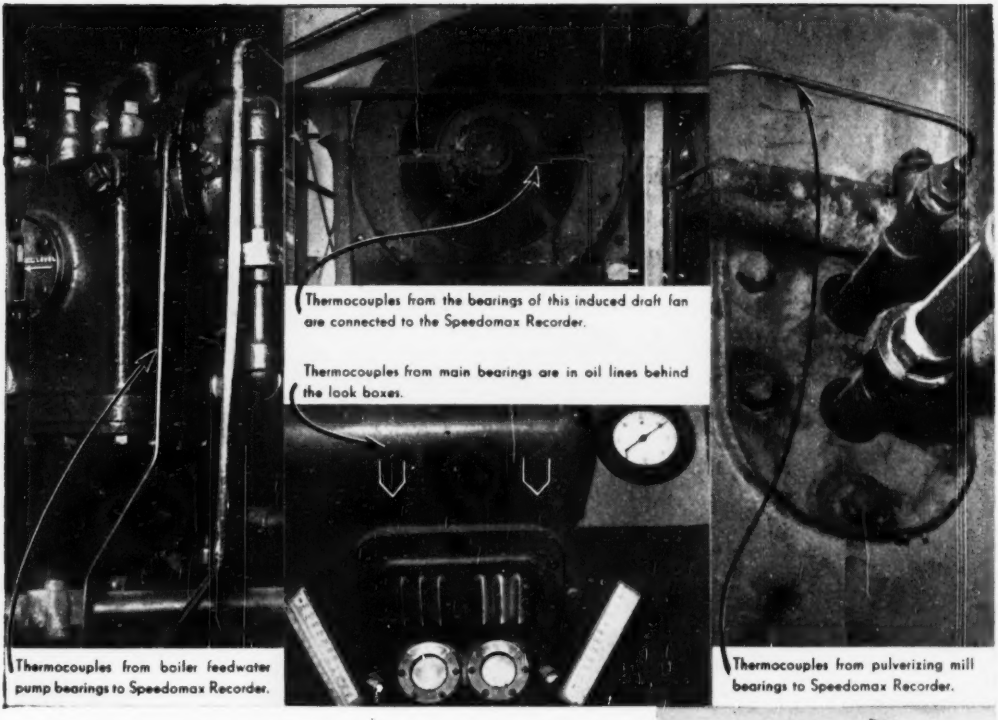
Continental-Diamond FIBRE COMPANY

Established 1895 . . . Manufacturers of Laminated Plastics since 1911 — NEWARK 15 DELAWARE



Thermocouples from boiler feedwater pump bearings to Speedomax Recorder.

Thermocouples from the bearings of this induced draft fan are connected to the Speedomax Recorder.

Thermocouples from main bearings are in oil lines behind the look boxes.

Thermocouples from pulverizing mill bearings to Speedomax Recorder.

Temperature From These 4 Points

. . . And 156 More . . .

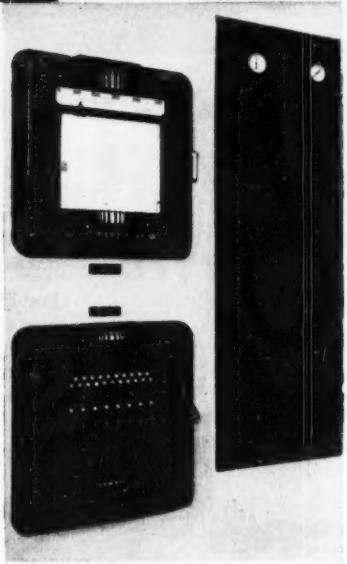
At ONE Speedomax Recorder

Remarkably fast, this new Speedomax offers a definite advance in temperature checking and recording. With Speedomax, an operator can "tour" the temperatures of 160 points in a little less than eleven minutes. He can watch readings as they are automatically indicated; or Speedomax will record them for later examination and for the shift log.

Readings are supplied in such rapid rotation, that it is generally possible to spot any high or low temperature as soon as it develops. In addition, greater operating efficiency is obtained because of the centralization of instrument readings.

The installation procedure is entirely standard. The company's staff simply installs thermocouples at those points from which they desire temperature readings. Couples are connected to the Speedomax equipment in banks of 20 each, with as many as eight banks. Appropriate alarms may be included.

For further information about this versatile temperature checking equipment, simply write for your copy of Folder ND46-33A(1). Address Leeds & Northrup Co., 4938 Stenton Avenue, Philadelphia 44, Penna.



Speedomax Recorder for all points shown and enough more to record a total of 160.

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

LEEDS & NORTHRUP CO.

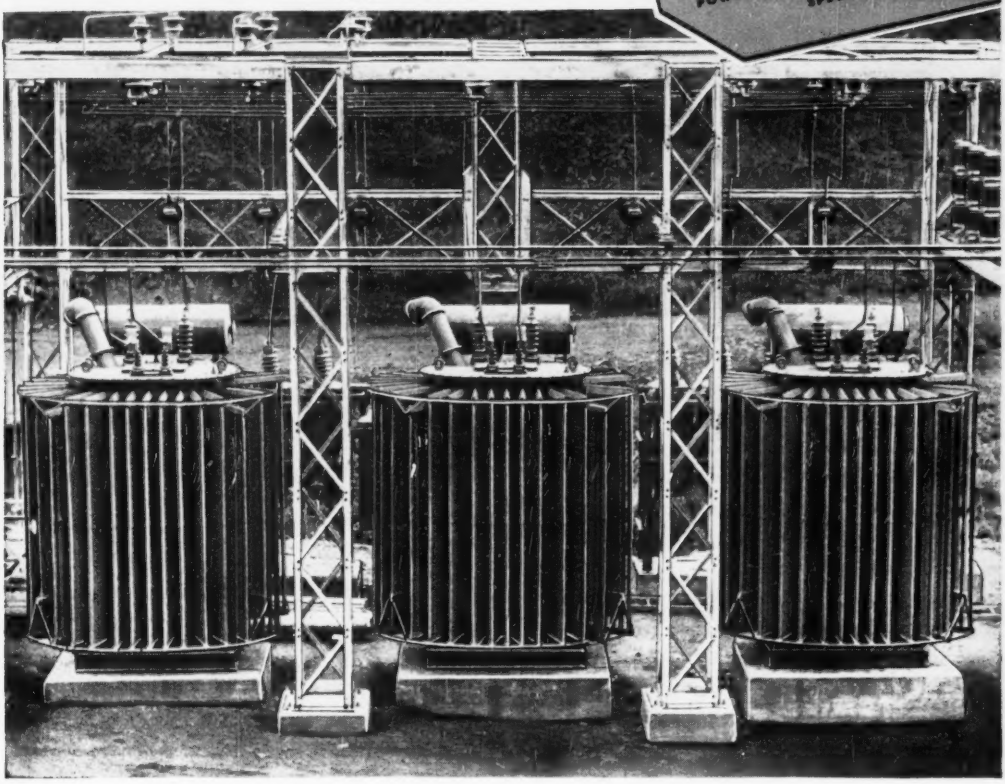
Jrl. Ad ND46-33A(2)

A DEPENDABLE Link

for Industrial Power Systems

Uptegraff TRANSFORMERS

POWER · DISTRIBUTION · INSTRUMENT SPECIALTY



The three 5,000 KVA Uptegraff Power Transformers shown above, serving an industrial plant in West Virginia, are 33,000 volt, 60 cycle, single phase, oil-immersed, self-cooled units.

Uptegraff offers a complete line of transformers for indoor or outdoor service, with sizes from 1/10 to 10,000 KVA. Types include: Power, Distribution (both dry type and liquid cooled), Instrument and Specialty.

We can quickly meet your needs with dependable transformers designed and built to your specifications.

R. E. UPTEGRAFF MANUFACTURING CO. SCOTTDALE, PENNSYLVANIA

Rome RoZone

WHERE HIGH VOLTAGES ARE A PROBLEM

500,000 CM stranded single conductor RoZone insulated, shielded, RoPrene sheathed, power cable....5000 volts

RoZone, the superior ozone-resistant insulating compound, did not just happen . . . it is the result of intensive research and development by "Rome" technicians. Behind it is the accumulated "know-how" of men long-experienced in cable design working with modern and completely equipped facilities.

As an oil-base type compound, RoZone combines exceptional resistance to corona action with high electrical stability in water and long life. It exceeds all requirements of ASTM specification D 574, as well as other severe performance specifications. Specifically, cables insulated with RoZone are unexcelled for high voltage underground or aerial distribution circuits, series street lighting installations, or any high voltage requirement, as well as general purpose wiring *where consistently high quality is a factor.* For circuits of 8000 volts or less between phases and operation at conductor temperatures up to 75° C., RoZone insulation will give you a *new standard* for uninterrupted service and long life. You can specify RoZone with confidence.

COMPARE THESE TEST RESULTS

1. AGING. No appreciable deterioration after exposure to heat or oxidation.
2. INSULATION RESISTANCE. Several times in excess of the ASTM megohm-constant requirement of 2000. Rome Cable has established the standard megohm-constant for RoZone at 5280.
3. DIELECTRIC STRENGTH. Actual long-time test results on RoZone insulation, for 5000 volt services, exceed 400 volts per mil. Surge or impulse strength values of RoZone are equally high.
4. OZONE RESISTANCE. Practically unaffected by exposure to corona or other ozone generating conditions.
5. DIELECTRIC LOSS. Typical test values indicate a power factor less than 4. percent and a dielectric constant under 4.5.
6. ELECTRICAL MOISTURE RESISTANCE. RoZone possesses remarkable stability after long-time immersion periods as exemplified by only minor changes in its electrical characteristics.

RoZone insulation is available in either shielded or unshielded construction with RoPrene (Neoprene) sheath or other conventional coverings to your specification.

Send for your copy of RoZone specification data today. In it you will find complete electrical and physical characteristics, as well as results of competitive independent laboratory tests. See for yourself why RoZone is specified by leading utilities and industrials.

FROM BAR TO FINISHED WIRE

ROME CABLE CORPORATION

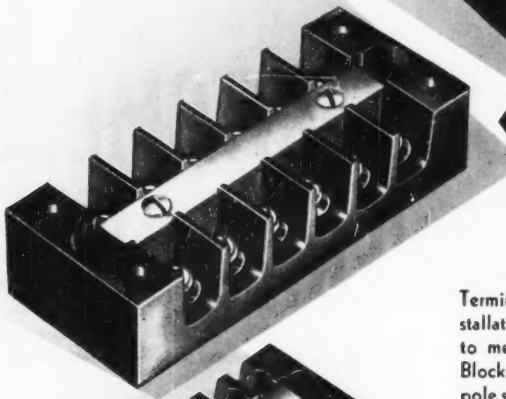
ROME • NEW YORK

Complete line of
TERMINAL BLOCKS

10 Styles . . . for all applications. Each available in many wire sizes; 2 to 12 wires. Molded bakelite blocks, cured under high pressure, assuring uniform density and freedom from flaws.

SERIES 1000 . . . for Space Economy. Due to extreme compactness combined with heavy duty rating, these are the most popular terminal blocks. Shown at right, actual size. Rating 30 amp. 750 v. Simple connector--no special terminal, no looping of wires.

Clamp type Connector, used with Series 1000 (above)



SERIES 6000, second only to the Series 1000 in popularity. Higher short time ratings are obtainable by adding jumper bars. Overall dimensions are same as for the Series 2000 and 3000, making it easy to combine these types. (15% wider than the Series 1000, and averaging 50% longer).

Terminal blocks for any standard control wiring installation, plus an infinite number of combinations to meet special problems of wiring connections. Blocks with center barriers . . . with single or double pole switches, for frequent sectionalizing . . . equipped for front-of-board mounting . . . with shorting strips, hinged covers, other accessories. Write for Catalog, giving detailed information.

SOLD BY LEADING WHOLESALERS

PENN-UNION ELECTRIC CORPORATION • ERIE, PA.

Canada: Dominion Cutout Company, Ltd. 250 Richmond St. West, Toronto

The Complete Line of Conductor Fittings

PENN-UNION

KAISER ACSR CUSTOMERS GETTING DELIVERIES NOW!

A MAJOR NEW SOURCE of aluminum conductor is now making high quality ACSR.

Permanente Metals' new plant, centrally located at Newark, Ohio, is producing—*and shipping*—Kaiser ACSR.

Initial orders are going to REA-financed Co-ops, U. S. Bureau of Reclamation, Bonneville Power Administration, and public and private utilities from coast to coast.

Assuring the high quality of Kaiser Aluminum Cable and ACSR is the most modern rod, bar, wire, and cable production equipment in the aluminum industry—manned by experienced, highly skilled personnel. A full range of standard strandings and sizes is being produced.

Do you need aluminum conductor? If you act now you may be able to take advantage of some early delivery schedules which are still open. Contact any office of Permanente Products' nationwide sales organization.

Permanente Metals

PRODUCER OF

Kaiser Aluminum Cable

SOLD BY PERMANENTE PRODUCTS COMPANY, KAISER BUILDING, OAKLAND 12, CALIFORNIA . . . WITH OFFICES IN:
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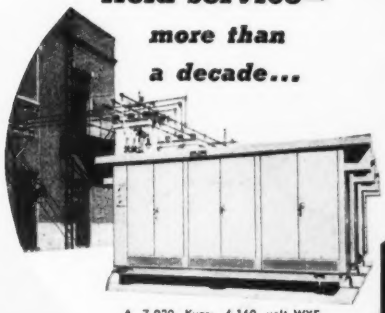
Also available through General Electric Supply Corp., Westinghouse Electric Supply Co., and Line Material Company

field service—
more than
a decade...



A 7,920 Kvar; 4,160 volt WYE, outdoor station-type C-D installation totalling 47,520 Kvar.

CORNELL-DUBILIER CAPACITORS FOR POWER-FACTOR IMPROVEMENT

What goes into a C-D power-factor capacitor? The finest components and construction, of course . . . *plus* the "fourth dimensional" quality you can't see: the C-D "know-how" that comes from years of experience in building capacitors for power-factor improvement. That's why C-D installations remain in service for *years*—with little or no maintenance. And that's why leading utility engineers specify C-D. Consult your local C-D field engineer, or write for technical data to Cornell-Dubilier Electric Corporation, Dept. D79, South Plainfield, New Jersey. Other plants in New Bedford, Worcester, and Brookline, Mass.; Indianapolis, Ind.; Providence, R. I. and Cleveland, Ohio.

Follow the leaders

Demand dependable C-D Capacitors—built by capacitor specialists.

1910 1949
Reg. U. S. Pat. Off.

C-D Best by Field Test!

CORNELL-DUBILIER WORLD'S LARGEST MANUFACTURER OF CAPACITORS

COMING THROUGH!

Simplex Paper-Insulated Cables ARE "DELIVERING THE GOODS" WHERE LARGE AMOUNTS OF POWER MUST BE TRANSMITTED AT HIGH VOLTAGES

And little wonder. For only the finest in design, materials, and workmanship goes into the manufacture of Simplex Paper Cables . . .

. . . Paper insulation that features high dielectric strength, low dielectric losses and low power factor, and which can be used at copper temperatures up to 85°C., depending on the operating voltage.

. . . Impregnating oil that is free of gas, moisture, and impurities.

. . . Metallic shielding or belting to best meet the conditions under which the cables must operate.

. . . Lead sheaths which, through sound foundry practice and careful extrusion, are unimpaired by oxides, poor welds and eccentricity.

All add up to performance that's trouble free; performance you can depend on.

Simplex Paper Cables are made in single or multi-conductor types, protected by a lead sheath alone, or by a lead sheath with wire armor or a reinforced rubber jacket. They are suited for use in underground, aerial, and submarine installations. Write us at the below address for full details.

SIMPLEX WIRES & CABLES

SIMPLEX WIRE & CABLE CO., 79 SIDNEY ST., CAMBRIDGE 39, MASS.

Because you demand your switches

RUGGED

PENELEC'S new sub-station at Warren, Pa. uses R & I E Hi-Pressure Contact Switches

CHECK the FACTS

1. RUGGED CONTACTS — Hi-Pressure, self-cleaning. Fortifies a critical point in switch service.
2. RUGGED BLADE OPERATING MECHANISM — high strength, simple leverage — with continuous motion, first releases contact and then opens blade. Reverse for closing.
3. RUGGED FLEX CONNECTION — a tight, bolted electrical connection — properly applied to blade motion.
4. RUGGED TERMINALS — Clamp type, with four half-inch bolts spaced 1¾". Trussed for strength and safety.
5. RUGGED BEARING — Stainless ball bearing, weather-sealed in heavy, galvanized, malleable one piece housing.
6. RUGGED NON-CORROSIVE BASE — Made of welded aluminum structural members.

The Check List

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INDOOR AND OUTDOOR

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INTERRUPTER SWITCHES

CUTOUTS AND THERMO-RUPTERS

DISTRIBUTION EQUIPMENT

SWITCH OPERATING MECHANISMS

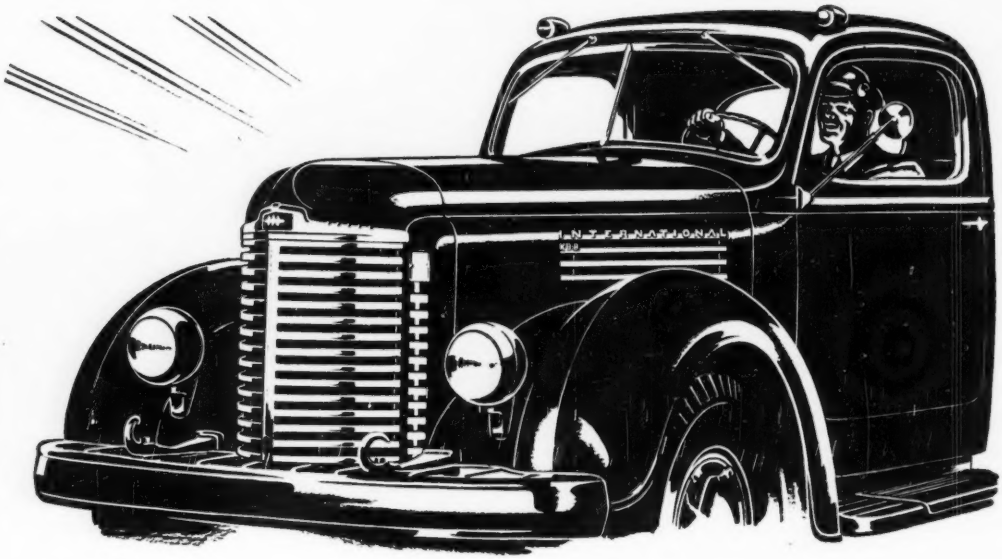
SUBSTATIONS

R&IE

RAILWAY AND INDUSTRIAL ENGINEERING CO., GREENSBURG, PA.

AFFILIATED WITH THE I-T-E CIRCUIT BREAKER CO., PHILADELPHIA, PA.
IN CANADA — EASTERN POWER DEVICES LIMITED, TORONTO

First in heavy-duty truck sales for 17 straight years!



America's most exacting truck buyers AGAIN give Internationals a vote of confidence!

Actual 1948 registration figures for new trucks of 16,001 pounds and greater GVW ratings show this nationwide preference for Internationals:

Internationals	**26.4%**
Truck "B"	**14.3%**
Truck "C"	**13.3%**

This marks the 17th successive year that Internationals have led in heavy-duty truck sales! Would men who buy on a basis of performance give a No. 1 rating to any truck unless it gave them a No. 1 value?

Outstanding value—right down the line! The same basic values that have kept Internationals first for 17 straight years in the heavy-duty field, are yours in any International Truck model. Heavy, light, or medium-duty, your International Truck is *all* truck. There's no compromise with passenger car design.

Trucks built to meet your requirements. Among the 22 basic International Truck models and 1,000 different truck combinations, there's a truck that's right for *your* job. In the range of gross weight ratings, from 4,400 to 90,000 pounds, you get the power, the frames, the axles you need for efficient hauling.

PLUS—the nation's largest exclusive truck service organization! 4,700 International Truck Dealers and 170 Company-owned Branches are ready with trained mechanics, precision-engineered replacement parts and low-cost rebuilt exchange units . . . ready to keep your International rolling at peak efficiency.

A truck transportation engineer is ready to help you! Call your nearest International Dealer or Branch, and find out how Internationals can step up the efficiency of your hauling. Trained International Truck transportation engineers will help you analyze your job—recommend a truck to lick it. If you're interested in profits, you'll call *soon!*

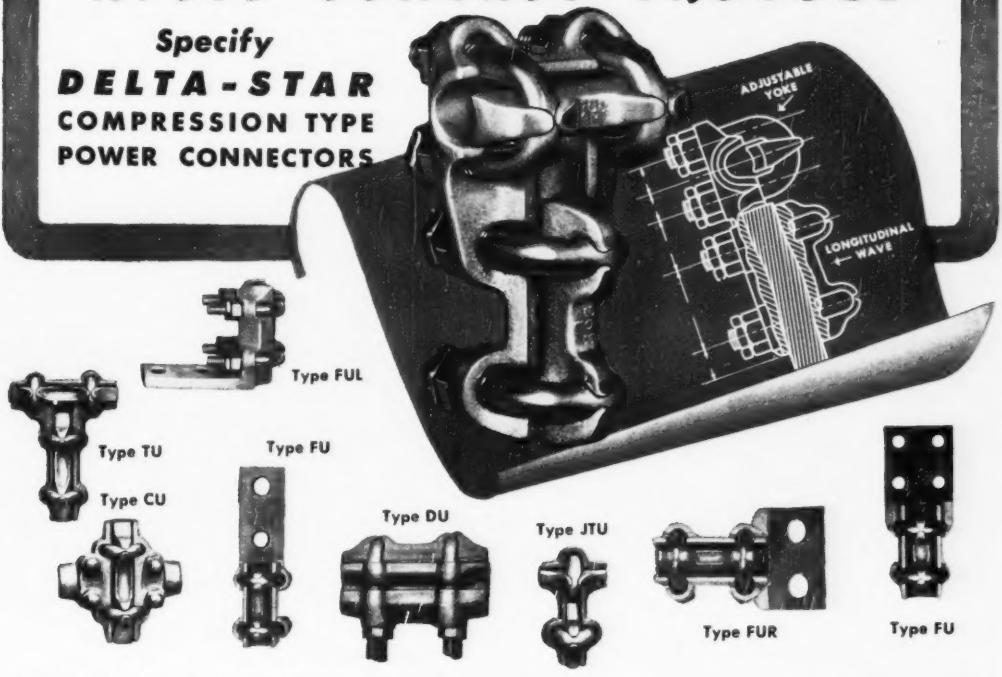
International Harvester Builds McCormick Farm Equipment . . . Farmall Tractors . . . Industrial Power Motor Trucks . . . Refrigerators and Freezers

INTERNATIONAL TRUCKS

INTERNATIONAL HARVESTER COMPANY • CHICAGO

AVOID CONTACT TROUBLE

Specify
DELTA-STAR
COMPRESSION TYPE
POWER CONNECTORS



Correct design of Delta-Star high compression type connectors for cable is proved by their universal acceptance, and excellent service record on today's heavily loaded circuits.

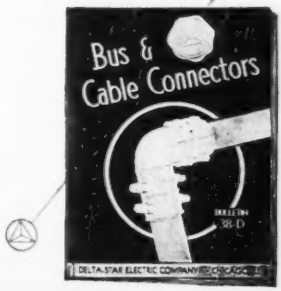
The Delta-Star high compression connector is of a patented design utilizing an adjustable yoke and U-bolts to provide constant and permanent pressure on the conductor. A longitudinal wave is cast in both yoke and connector body, so a definite wrapping action is secured as bolts are tightened—slightly deforming the conductor and providing positive pressure between all strands. The result is a permanent high conductivity joint of great mechanical strength. Material is high strength copper alloy. "Duronze," non-ferrous U-bolts and nuts are used thruout.

To facilitate installation U-bolts are securely held in position by bent over yoke projections, making yoke and U-bolt a one-piece unit.

These connectors are available in a Wide variety of fittings needed for connecting cable to cable, cable to bar or cable to tube. For copper or aluminum conductors.

YOURS FOR THE ASKING

Bulletin 38-D lists a complete line of standardized power connectors. Clamp or solder type, for round or square tubing, bar, cable or combinations of these.



DELTA-STAR ELECTRIC COMPANY

MAIN OFFICE AND FACTORY—2400 Block, Fulton St., Chicago 12, Ill.
NEW YORK OFFICE—140 Cedar St., New York 6, N. Y.

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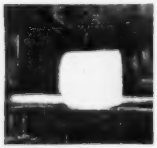
CANADIAN ASSOCIATE
Canadian Line Materials Limited, Toronto 13, Canada

Metallurgical Research conducted continually by recognized specialists who have made major contributions in this field.

Unique Technical Backing of an extensive organization with an international reputation in both process and fabrication engineering.

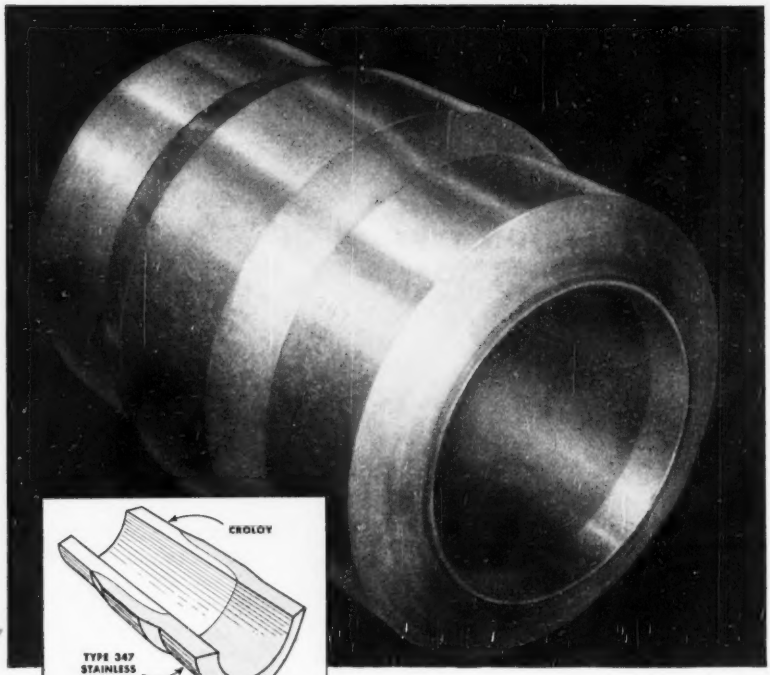


Complete Facilities for the fabrication of steel products from simple forgings to the most intricate 120 foot towers.

Top Welding Performance assured by specially designed equipment and exclusive employment of master operators.

Quality Control embracing the constant application of the most advanced inspection methods, both visual and non-destructive.

On-Time Delivery made possible by a flexible planning group authorized to re-route work to meet promised dates.



This had never been done before!

IN the first high-pressure power generating units to operate at 1050° F, just completed by the New Jersey Public Service Electric and Gas Company at Sewaren, N. J., Kellogg received the contract to fabricate and supervise installation of the main steam piping. This high operating temperature posed many perplexing problems.

But the most unusual problem concerned something that *had never even been attempted before* under such high temperature conditions. This is the story.

Boiler leads were 3% chrome-1% moly steel. The turbine throttle valves were Type 347 stainless steel. They had to be connected. However, engineers felt that welding these two diverse metals together might prove a weak point in the system because of the great difference in their coefficients of expansion.

Kellogg studied the problem and came up with the suggestion of creating *a completely new type of transition piece*, one end of which would be chrome-moly and the other stainless steel so that similar metals would be welded together. But the creation of such a piece was no simple task.

First, by their exclusive electric-ingot process, Kellogg cast the stainless steel section integrally on a chrome-moly forging. A special alloying technique was employed in the casting process which resulted in a gradual transition in analysis from one metal to the other. The piece—pure chrome-moly at one end and pure stainless at the other—was then machined to the correct inside diameter and outside dimensions.

Although a dramatic one, this is just another example of Kellogg's unusual accomplishments in the field of high temperature piping. Every day brings to light some instance where the metallurgical knowledge and unmatched facilities of Kellogg contribute to the successful solution of some new problem—producing an ordinary piece of equipment in a slightly better form or evolving an entirely new and more efficient way of performing some unusual task.

To master temperature, pressure and chemicals use

M. W. KELLOGG

process equipment

VESSELS • EXCHANGERS • CONDENSERS • HIGH PRESSURE AND HIGH TEMPERATURE POWER PIPING PROCESS PIPING • FORGED AND WELDED FITTINGS . . . IN ALL STEELS, ALLOYS OR SPECIAL COMBINATIONS

The M. W. Kellogg Company, Inc. (A Subsidiary of Pullman, Inc.) — Offices in New York, Jersey City, Buffalo, Los Angeles, Tulsa, Houston, Toronto, London and Paris.

BLACKBURN *Hi-Strength* TWO-BOLT CLAMP

ECONOMICAL! EFFICIENT! COMPACT!

A BETTER CABLE CONNECTOR AT LESS COST!

- Especially designed for medium and large stranded wire and cable.
- Produces very high clamping pressure resulting in low resistance joints on stranded wire.
- It costs much less than other types of connectors commonly used.
- It is excellent for dead ends, taps, and service entrance connections and will accommodate a range of wire sizes.
- Exclusive helical serrations in both body and cap, conforming to the lay of stranded wire, together with the high clamping pressure produce a joint which will not pull apart. Thus the Blackburn Two-Bolt CLAMP is excellent for dead ending.
- It's made of high strength alloys throughout. Its extra strength maintains the high "pressure between wires" indefinitely. Thus it makes a lasting, trouble-free connection.
- It's compact and easy to tape — makes a neat joint.
- It's simple and easy to install.
- Made in sizes 1/0 to 1000 MCM.

Jasper Blackburn Products Corp.

Builders of Quality Connectors for 15 Years

FIRST, MADISON AND CLINTON STS. • ST. LOUIS 6, MO.
Phone CEntral 3007

Mail Coupon for Sample and Full Details

Send me sample and further information on the BLACKBURN TWO-BOLT CLAMP.

Wire Size Used_____

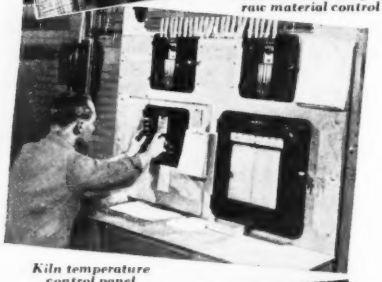
Your Name_____

Company_____

City & State_____ EW

The completely modernized Victor plant; over 300,000 sq. ft. of manufacturing space

Ceramic laboratory—raw material control



Kiln temperature control panel

Routine high frequency and 60 cycle flashover

PLANT PERFORMANCE THAT MEANS

Peak Performance

IN HIGH VOLTAGE INSULATORS

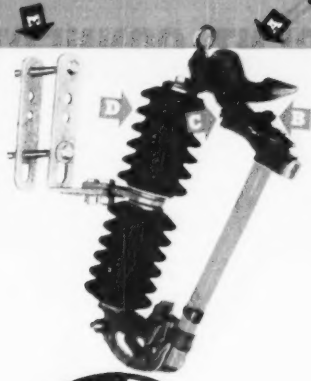
High voltage porcelain insulators made at Victor have been acclaimed for their performance on important transmission and distribution systems the world over. This "on-the-job" performance is the result of top performance right in the Victor plant. Through the various processes of porcelain production . . . mixing, extruding, forming and glazing . . . firing, assembling and testing . . . CONTROL is the watchword. It is this modern plant-wide control which assures high voltage insulators of superior performance—*electrically, mechanically, dimensionally.* For your standard or special insulator requirements, specify Victor!

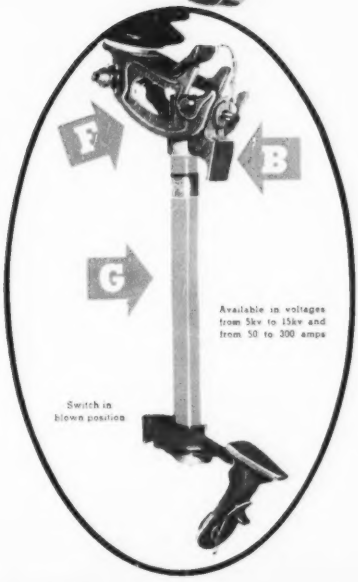
VICTOR
INSULATORS Inc.
VICTOR, NEW YORK

Look for this trade mark of enduring service

V

DEPENDABLE PROTECTION WITH





Type 33 Dropout CUTOUTS

A Sleet-shield top latch provides dependable operation under all weather conditions.

B Positive dropout action is assured by knee-action mechanism at top and bottom of tube assembly.

C Dependable operation at full rated current is assured by evenly distributed pressure and full wiping action of solid copper contacts.

D Insulator replacement costs are lower with Southern States two-piece insulator units.

E Universal mounting bracket provides either cross-arm or pole mounting.

F Self-locking hinge prevents tube falling out on down swing.

G Positive semaphore! Completely open position provides unmistakable indication of blown fuse. Tube quickly and easily removed and replacement installed with hook stick.

WRITE FOR BULLETINS ON THE ENTIRE LINE

Southern States Equipment Corp.

HAMPTON GEORGIA

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Here's why

BURNDY HYDENT CONNECTORS

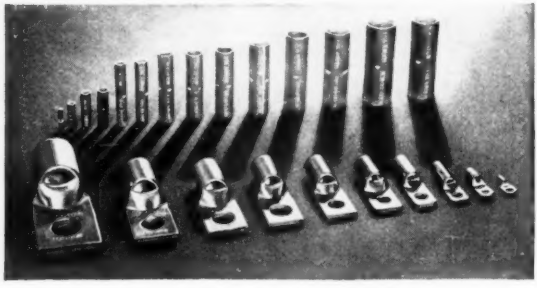
are superior mechanically... electrically

No art tricks . . . this is a cross section photo of a typical HYDENT connection.

Note how the conductor and connector have been compressed into an almost solid mass under high pressure by the Burndy HYPRESS or HYTOOL.

And there's no trick to cutting costs the modern HYDENT way. Just insert conductor, indent with the HYTOOL, and, *presto*, the job is done.

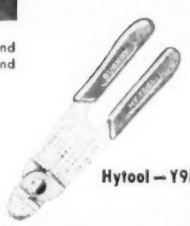
HYDENT connectors are available in all types for conductors #22 through 2000 Mcm . . . all one-piece, pure copper construction, heavily tin-plated. Catalog Y46 gives the complete story. Send for your copy today.



Hydent Connectors range from the smallest sizes used for control, instrument and electronic equipment wiring to the largest cable sizes required in industrial and utility power applications.

Connect with
BURNDY
New York 54, N. Y.

Burndy Hytools and Hypresses indent Hydent connectors onto all conductors from #22 to 2000 Mcm.

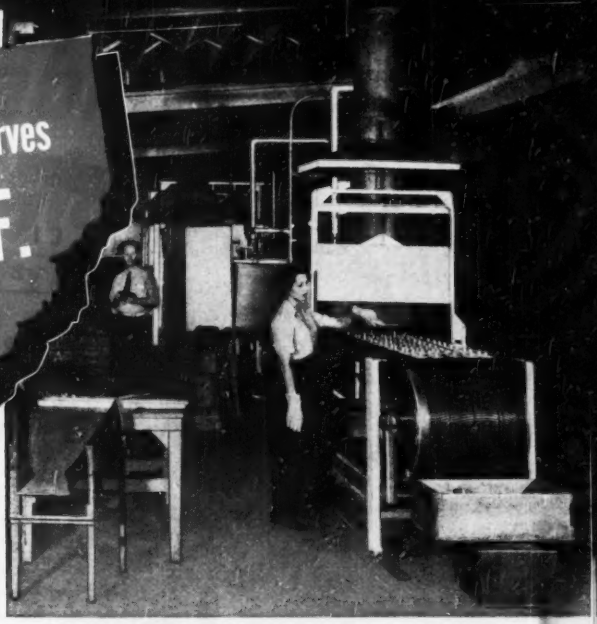


Hytool—Y9M

Hypress—Y34-A

WESTERN BRANCH: Vernon 11, California • CANADA: Canadian Line Materials, Ltd., Toronto 13

Record-breaking NICHROME* V Belt serves 7,000 hours at 2050°F. in Copper Brazing Furnace!



Delivery end of electric copper brazing furnace operated by National Stamping Company—brazed steel parts being delivered by continuous-mesh Nichrome V Belt.

BELT SPECIFICATIONS
length: 98' 6"
width: 20"
mesh: 3/8"
wire: 12 gauge Nichrome V

. . . actual life of this belt extended for many thousand hours more (a large percentage of the time at steel annealing temperature of 1840°F.), but its long service at 2050°F. makes its performance outstanding . . . in fact, puts this belt "at the head of the class."

For though wire belts may last, according to an internationally recognized furnace manufacturer, "practically forever" at lower temperatures such as 1300°—1400°F.—often employed for considerable periods in furnaces of this type—their useful lives are measured by service rendered under heat at 2050°F.

ALL KNOWN RECORDS BROKEN

Says Ashworth Bros., Inc., maker of the belt: "This Nichrome V wire belt was installed in a modern electric copper brazing furnace and operated at the Detroit plant of National Stamping Company from June 1, 1947 to September 24, 1948. Its history, including approximately 7,000 hours at 2050°F. under full load, indicates ***it broke all records for this type of service.***"

MORE OUTSTANDING FACTS

Further information only emphasizes the noteworthy performance of this veteran piece of furnace equipment. For example:

(a) Belt Size—belts of this size, 98' 6" long x 20" wide, must be exceptionally stable to give such long and efficient service.

(b) Production—approximately 380 lbs. of work were handled per hour.

YOUR HEAT-TREATING PROBLEMS AND DRIVER-HARRIS

In selecting *your* heat-treating equipment, remember the outstanding ability of Nichrome V to give top-level performance at high temperatures, such as that of copper brazing. And remember, too, that Driver-Harris has been engaged in finding the correct answers to furnace problems for more than 35 years. Our accumulated experience and unique specialized knowledge will help you to lower operating costs, reduce maintenance, minimize repairs, increase production.

Feed end of furnace—parts being placed on Nichrome V belt

(This belt supplied by Ashworth Bros., Inc., Worcester, Mass.)

50TH YEAR
SPECIAL PURPOSE ALLOYS SINCE 1899
D/H
TRADE MARK REG. U. S. PAT. OFF.
1899 - 1949

Nichrome is manufactured only by

Driver-Harris Company

HARRISON, NEW JERSEY

BRANCHES: Chicago, Detroit, Cleveland, Los Angeles, San Francisco, Seattle

*T. M. Reg. U. S. Pat. Off.

LIGHT IN WEIGHT

BIG IN VALUE

B37 Paving Breaker

joins famous Gardner-Denver family

Weighs only 38 pounds! Yet the Gardner-Denver B37 Paving Breaker is packed with many of the same big values that have proved so popular in the medium B67 and heavy B87 machines.

The tough-slugging B37 makes fast work of light demolition jobs. It's light and safe in the hands of the operator who must work from scaffolding, or wherever footing is treacherous. It's built to endure years of hard work. Here are some of the reasons why:

Renewable chuck liner — easily replaced at low cost — a new liner protects both tool and breaker against a loose-fitting shank.

Double-life hammer — block type piston hammer is reversible for double life — an exclusive feature. Use of tappet minimizes wear on hammer striking face. Tappet operates in renewable bushing.

Extra safety — exclusive throttle valve lock works like the safety on a gun — prevents accidents before they happen.

Easy riding — fast cutting action without violent recoil means less operator fatigue. Holding handles stay cool.

Low air consumption — with efficient low-lift plate valve. Long piston stroke gives hard-hitting blow. Exhaust will not "freeze."

Quick acting latch type steel retainer — holds tool securely.

Positive lubrication — integral oil reservoir meters oil to every working part, including tool shank. Lubricated shank reduces chuck wear and breakage of gads.

For complete information, write Gardner-Denver Company, Quincy, Illinois. In Canada: Gardner-Denver Company (Canada) Ltd., Toronto, Ontario.

B67

B87

Specifications for GARDNER-DENVER B37 PAVING BREAKER

Weight	38 lbs.
Piston Diameter	1 7/8"
Length	22"
Size of Tool Shank	1" Hex. x 4 1/4"
Air Hose Recommended	3/4"
Weight, Boxed for Shipment	61 lbs.
Boxed Dimensions	8" x 16" x 26" 1.9 cu. ft.

GARDNER-DENVER

SINCE 1859

Proved Reliability, Proved Low Maintenance

by Years of Trouble-Free Use on many Important 115-kv lines

PACIFIC ELECTRIC
Type JWE-58
Oil Circuit Breaker
115 kv, 800 amp, 1,500,000 int. kva.
5-cycle trip, 20-cycle reclose
Other 115-kv types for higher interrupting ratings

Pacific Oil Circuit Breakers with direct-gas-blast Expulsion Chambers have many design features which contribute to reliable service and reduced upkeep costs, including

1 *Complete Motor-Compressed-Spring Operating Mechanism*

The reliability and uniform characteristics of the coil spring—universally used for circuit-breaker opening—is also applied in the Pacific breaker to **closing.**

- Insures identical closing speeds for successive operations, no matter how frequent
- Reduces maintenance cost

2 *Sliding-Shoe Contacts*

Each square-section blade slides between four self-aligning contact shoes, pressure-spring applied to the respective four sides of the blade.

- Eliminate shock on bushings during closing
- Reduce arcing time because opening occurs after blades attain high speed
- Wiping action reduces pitting and maintenance
- Electromagnetic forces tend to increase contact pressure, rather than reduce it
- Leaf springs apply nearly constant pressure regardless of wear of shoe, eliminating need of adjustment
- No sensitive blade-position adjustment is required to fix closed position.

Call **PACIFIC ELECTRIC MFG. CORPORATION**
5815 THIRD STREET, SAN FRANCISCO 24, CALIFORNIA • P. O. BOX 419, GARY, INDIANA

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Why I Purify Insulating Oil at Low Temperatures

ADVANTAGES OF DE LAVAL INSULATING OIL PURIFIERS

- Dehydrates at a single pass — no re-running
- Constant high purifying efficiency — no shutdowns for cleaning or for renewal of parts during run
- Safest — continuous discharge of water prevents re-contamination of the insulating oil
- Removes water without aid of filter press; press used only to remove colloidal carbon
- Low temperature purification; high dielectric value of oil maintained longer
- Heater cannot carbonize the oil
- Higher daily capacity of purifier saves maintenance costs
- More economical to operate

"I am De Laval Centrifugal Force. I dehydrate insulating oil at low temperatures. I produce results that are more satisfactory than those obtained by methods of maintaining oil that demand relatively high heat to drive off moisture."

Another advantage of low temperature purification obtained by De Laval Centrifugal Force is the elimination of the probability of condensate forming in the receiving tank.

De Laval Insulating Oil Purifiers are equipped with low watt density electric heaters which prevent carbonization of the oil. Heating costs are kept to a minimum.

De Laval centrifugals dehydrate insulating oil at a single pass. Because they discharge water continuously, they prevent any possible recontamination of the oil. Send for Bulletin TR-1.

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

De Laval

INSULATING OIL PURIFIERS

Completely NEW!

IN DESIGN AND PERFORMANCE

BETTER
than anything you have ever seen or tried before.

The answer to John Lineman's Prayer.

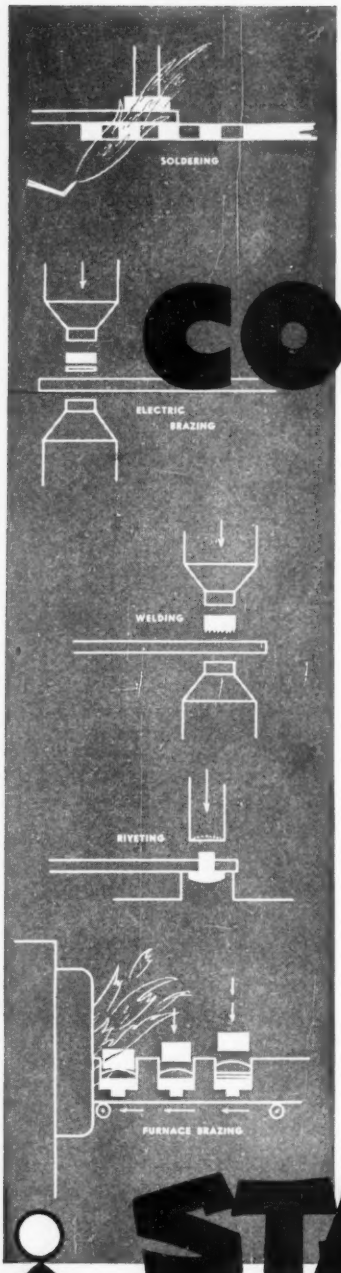
Perfectly aligned, ing. assembled, pin thimble-radio steel pin hole with Type "N" Glaze.
DATED! A permanent service record. And something new in contours—missle and moisture shedding—radio steel glaze at all assembly joints.
13/8" wire groove, 1/2" radius tie wire grooves—WOW!

A Complete Line to take care of Every Transmission Pintype Need.
(NEMA Standard)

The most radical departure from conventional insulator design in decades. Many designs were tried and tested. The final design is presented here. Utility Engineers, linemen and management will sing praises over the performance of these insulators for years to come. Write for folder describing the complete new line of Transmission Pintypes.

Porcelain Products, Inc.

PARKERSBURG, WEST VIRGINIA



A money-saving tip on

CONTACTS

LEADING users of Stackpole contacts for original equipment have saved money, assured greater product dependability, not only by having us recommend the most suitable method for attaching contacts to their arms, but also by letting us handle this specialized attachment job.

Based on long experience, Stackpole engineers are fully familiar with the advantages and disadvantages of the various attachment methods for different contact materials and applications. The best, most economical method can quickly be selected—and the entire operation handled on modern equipment and in such a manner that contact performance or durability will in no wise be impaired. Scrap contacts are eliminated—you pay only for those supplied in complete, properly attached form.

WRITE FOR CATALOG 12 describing Stackpole contact types and containing a wealth of helpful contact data including choice of contact materials and contact attachment information.

STACKPOLE CARBON COMPANY, St. Marys, Pa.

STACKPOLE

CONTACTS

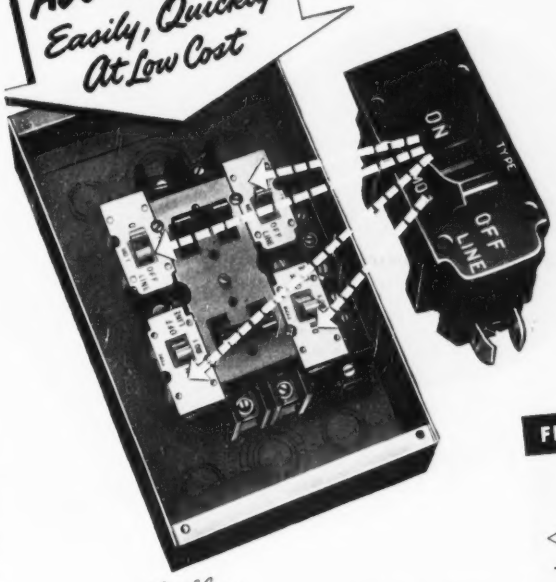
All shapes and sizes in SILVER GRAPHITE • SILVER LEAD OXIDE • SILVER NICKEL SILVER MOLYBDENUM • SILVER TUNGSTEN • COPPER GRAPHITE • PRECIOUS METAL

. . . and many special materials

"Ad-On" MULTI-BREAKER

TYPE MB-4 SERVICE AND LOAD CENTER

ADD CIRCUITS *Easily, Quickly At Low Cost*



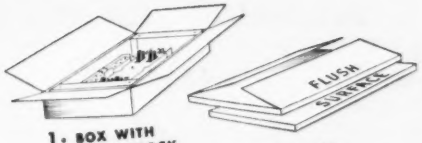
START WITH 4:

Basic circuit breaker unit provides 4 single pole, 1 double pole and 2 single pole, or 2 double pole circuits in combinations of 15, 20, 30, 40 or 50 ampere ratings.

ADD 4 MORE:

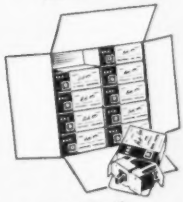
1, 2, 3, or 4 single pole circuit breaker units rated 15, 20 or 30 amperes are easily plugged in on basic block.

FLEXIBLE MERCHANDISING PLAN



1 • BOX WITH BASIC BLOCK

2 • FLUSH OR SURFACE TRIM



3 • "Ad-On" BREAKERS

a Small Stock of **COMPONENT PARTS** covers all job requirements when assembled in various combinations.

Coilless
Thermal Magnetic Multi-breaker

The basic **"Ad-On"** Multi-breaker unit provides four circuits—the *minimum* for a modern home. Even more important, it provides for easy addition of circuits *as they are needed*. Four off-the-shelf **"Ad-On"** breakers extend the range of the basic block in the required circuit pattern.

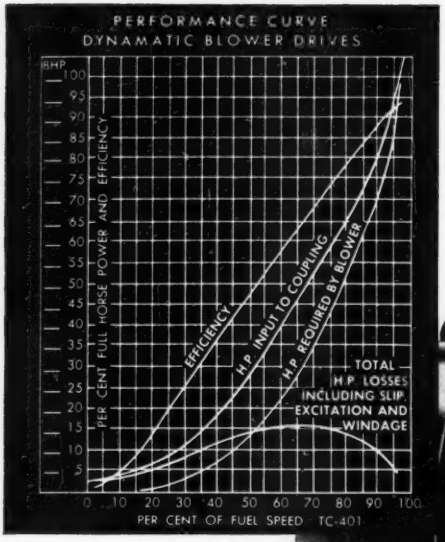
Architects, builders and contractors all know from experience that many electrical appliances are added after homes have been completed and lived in. With **"Ad-On"** breakers it's a simple matter to provide these circuits so necessary for better electrical living.

ASK Your Square D Electrical Wholesaler to Show You the "Ad-On"

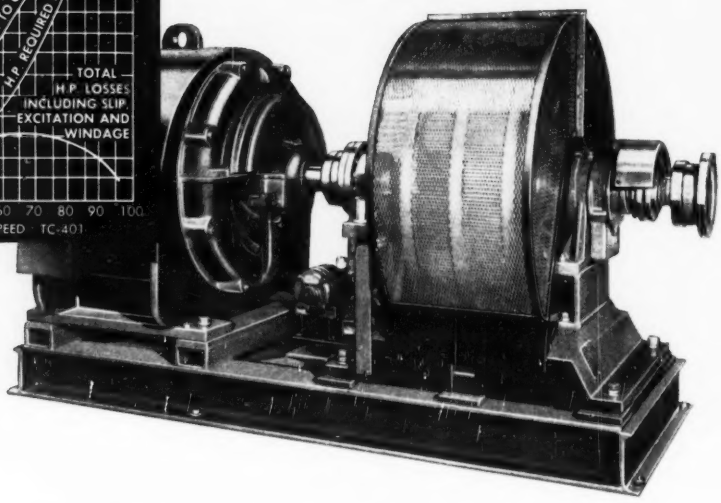
SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

SQUARE D COMPANY CANADA LTD., TORONTO • SQUARE D de MEXICO, S.A., MEXICO CITY, D.F.


PERFORMANCE CURVE
DYNAMATIC BLOWER DRIVES
BHP
PER CENT FULL HORSE POWER AND EFFICIENCY
EFFICIENCY
H.P. INPUT TO COUPLING
H.P. REQUIRED BY BLOWER
TOTAL H.P. LOSSES INCLUDING SLIP, EXCITATION AND WINDAGE
0 10 20 30 40 50 60 70 80 90 100
PER CENT OF FUEL SPEED · TC-401

EATON DYNAMATIC BLOWER DRIVES



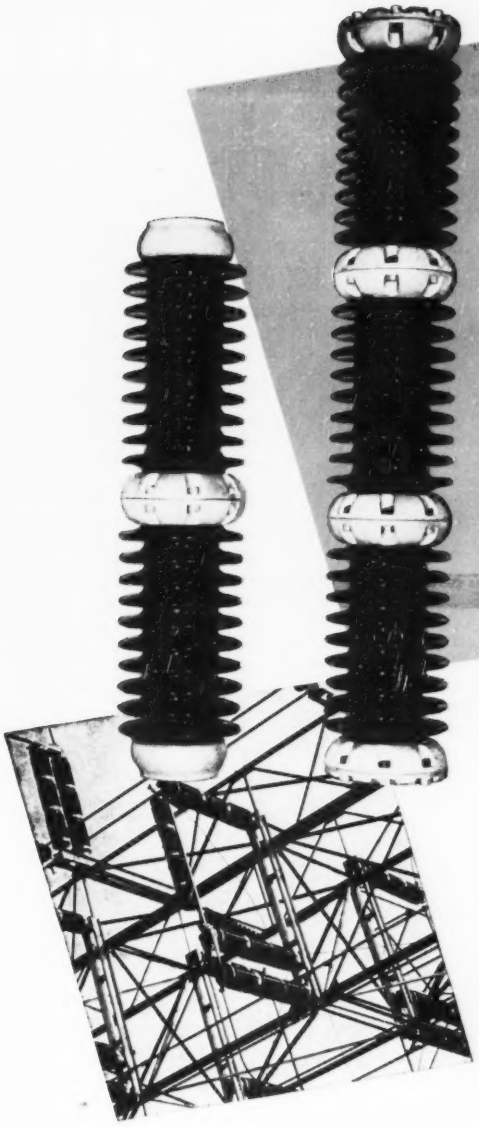
Instantaneous Response to Speed Control

Dynamatic Variable Speed Couplings are ideally adapted to such applications as regulating air drafts in steam generating stations, power house fan drives, public utility induced draft fans, and forced draft fans. Controls can be made to change the output speed of the coupling and hold that speed constant. Response is instantaneous and load changes are closely followed. The speed range available is practically infinite, and can be controlled precisely from ten per cent speed up to full speed.

The performance curve above indicates the characteristics of Dynamatic couplings when driving fans or blowers. Fundamentally, all fans and blowers will have curves very close to the ideal curves shown in this figure. Note the desirable relationship between efficiency, horsepower input, and required horsepower. The horsepower losses indicated are normal for this type of application. Both air cooled and water cooled types of Dynamatic couplings are available, selection depending upon loads and type of service involved. The electric-slip coupling was developed and introduced by Dynamatic; this company has pioneered the use of electric-slip couplings in fan and blower drive applications. Write for illustrated literature.

EATON MANUFACTURING COMPANY • CLEVELAND, OHIO
ADDRESS INQUIRIES TO: DYNAMATIC DIVISION • KENOSHA, WISCONSIN

PRODUCTS: SODIUM COOLED, POPPET, AND FREE VALVES • TAPPETS • HYDRAULIC VALVE LIFTERS • VALVE SEAT INSERTS • ROTOR PUMPS • MOTOR TRUCK AXLES • PERMANENT MOLD GRAY IRON CASTINGS • HEATER-DEFROSTER UNITS • SNAP RINGS • SPRINGTITES SPRING WASHERS • COLD DRAWN STEEL • STAMPINGS • LEAF AND COIL SPRINGS • DYNAMATIC DRIVES, BRAKES, DYNAMOMETERS



Mechanical Security
Electrical Security
Long Life . . .

AT VOLTAGES UP TO 161 Kv

LAPP STATION POSTS

It's a matter of record! The facts-and-figures on 17 years of service of Lapp Post insulators prove that lines and stations on this design have fewer outages, lower maintenance, better performance than lines and stations on any other insulators. It's a difference in engineering concept, a difference in construction—a difference that certainly justifies, for service at all voltages up to 161 Kv, the specification "Lapp Station Posts."

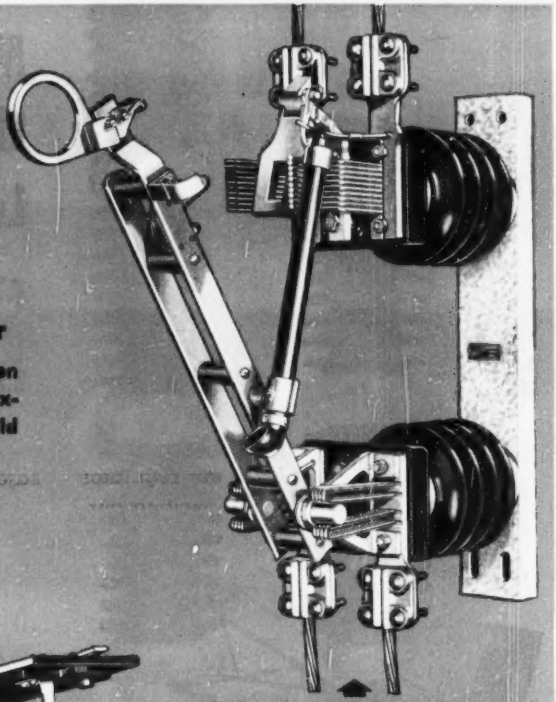
Lapp STATION POSTS

LAPP INSULATOR CO., INC. • LE ROY, N.Y., U. S. A.

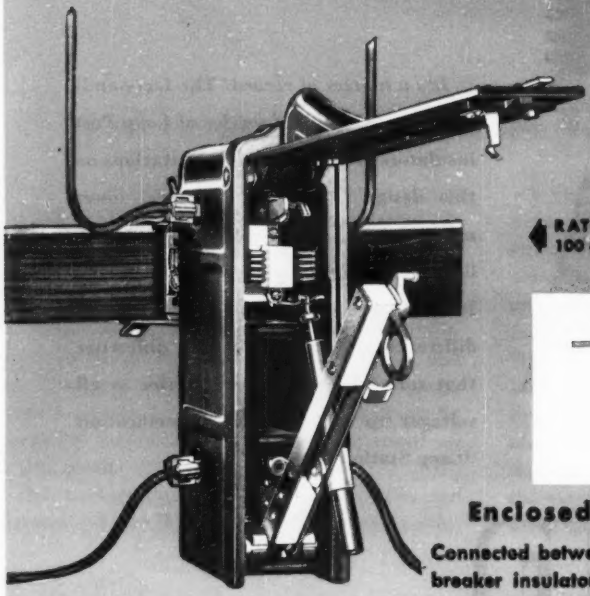
With Kearney REGULATOR

Open Type Surge Protector

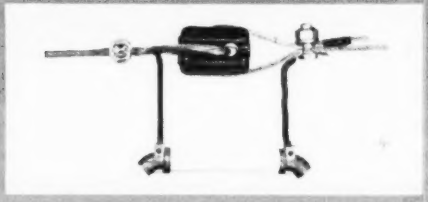
Mounted on the upper terminal of the open type regulator by-pass switch. If surges exceed 15,000 volts, this surge protector should be installed.



RATING: 15,000 V., 1,500 Lead
7,500 Volts, 750 Lead
200, 400, 600 Amperes



RATING: 7,500 Volts, 750 Lead
100 and 200 Amperes



Enclosed Type Surge Protector

Connected between upper leads to unit, or across the breaker insulator. If surges exceed 5,000 volts, you should install the surge protector.

BY-PASS SWITCHES

Safe Switching Sequence is *Automatic*

Pull one switch ring... the main line is by-passed, both leads to the regulator are opened, and the exciting current is safely interrupted, all in one quick, safe operation. Restoring the regulator in service is just a matter of reclosing the By-Pass Switch like operating any other disconnect switch.

All the hazardous elements of opening the wrong disconnect are removed when you use the Kearney By-Pass. The proper switching sequence is built into its operation. The question of which disconnect switch to pull first is safely and simply answered. There is only one ring to pull and that one takes care of four distinct switching operations in safe, logical order.

Kearney By-Pass Switches will fit into your present sub-station structures with room to spare. They have approximately the same overall dimensions as single pole hook operated disconnect switches, and you can replace three of these with a single Kearney By-Pass Switch.

For your new sub-stations, you can similarly save sub-station space by using one By-Pass instead of three disconnect switches. Furthermore, you can save up to 26% of the cost of disconnects by using Kearney By-Pass Switches.

For Better Results

Specify Kearney Products

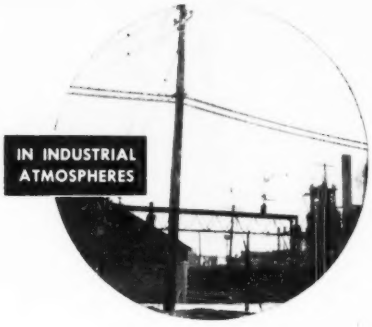
JAMES R. KEARNEY CORPORATION

OVERHEAD AND UNDERGROUND UTILITY EQUIPMENT

4224-42 Clayton Ave., Saint Louis 10, Mo. • Canadian Plant, Leaside, Ontario

RUST IS COSTLY!

PREVENT IT WITH



Copperweld
TRADE MARK

NON-RUSTING STRAND

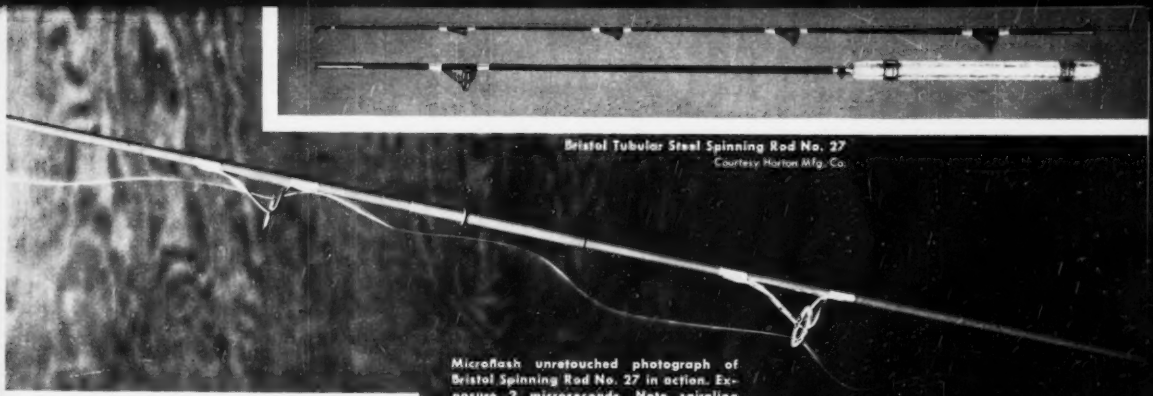
It's the thick copper covering on each of the wires that prevents Copperweld Strand from rusting—and protects each of the strong alloy steel cores *permanently*. That's why Copperweld guys and messengers retain their original strength, provide dependable, trouble-free support year after year.

And since it can't rust, Copperweld Strand will cost you less in the long run—replacements just aren't necessary.

This rugged strand is versatile in the field. It can be bent, served, moused or clamped. The natural ductility of copper and the strength of the molten-weld eliminate danger of cracking, flaking or peeling.

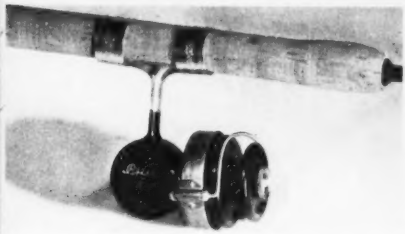
Engineering Data will be sent on request.

COPPERWELD STEEL COMPANY
GLASSPORT, PA.
Sales Offices in Principal Cities



Bristol Tubular Steel Spinning Rod No. 27
Courtesy Horton Mfg. Co.

Microflash unretouched photograph of Bristol Spinning Rod No. 27 in action. Exposure 2 microseconds. Note spiraling fishing line.
Courtesy Horton Mfg. Co.



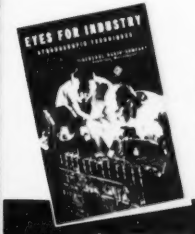
Bristol Spinning Reel No. 69
Courtesy Horton Mfg. Co.

Microflash Proof that a Spinning Line Spins

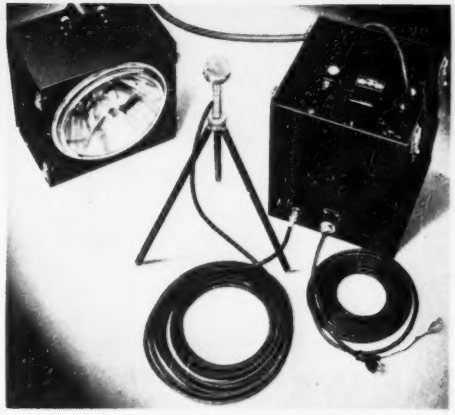
When the makers of the famous Bristol fishing rods produced a *spinning* rod and reel that promised a new high in the accuracy, ease, distance and pleasure of casting, they encountered the usual, "expert" skeptics. Did the fishing line really spin as claimed? The Horton Mfg. Co. believed that ultra-high-speed photographs might give the proof. So they wrote the General Radio Co. as follows:

> "It is our feeling that we will be able to show to the spinning experts for the first time exactly what action takes place as the spinning line leaves the reel and pays out through the *graduated* guides . . . and demonstrate the advantages of having graduated guides rather than the old type."

A series of Microflash photographs (of which one is shown) gave convincing evidence of the continuous spiraling, spinning motion of the line from the time it left the spinning reel until it passed through the last graduated guide on the end of the rod. It was evident that graduated guides (rather than the ordinary, small guides) were necessary to preserve the continuous, spiraling motion of the lines, to reduce friction and to prevent choking of the line.



Write for your copy of 24 page manual of stroboscopic techniques "Eyes for Industry".



Microflash Does It Again!

This is one more example of the value of ultra-high-speed, stop-motion photography in industry and research. The Type 1530-A Microflash will stop cold any motion which does not exceed 2 millionths of a second in duration, including projectiles in motion, pressure waves in gases, mechanical distortions at high rotational speeds, turbulence in liquids and many others. The Type 1530-A Microflash can be used with conventional camera equipment, is portable and operates on ac.

TYPE 1530-A MICROFLASH SPECIFICATIONS

Flash: 2 microseconds.

Power Supply: 105-125, 210-25 volts. 50 to 60 cycles.

Power Input: 70 Watts.

Accessories Supplied: Microphone, tripod, spare pilot lamp and fuses; 2 spare flash lamps, plug.

Mounting: Power supply and trigger circuits in one metal case, the lamp in another. Cases lock together for travelling.

Dimensions: 24⅛ x 13¼ x 11¾ inches.

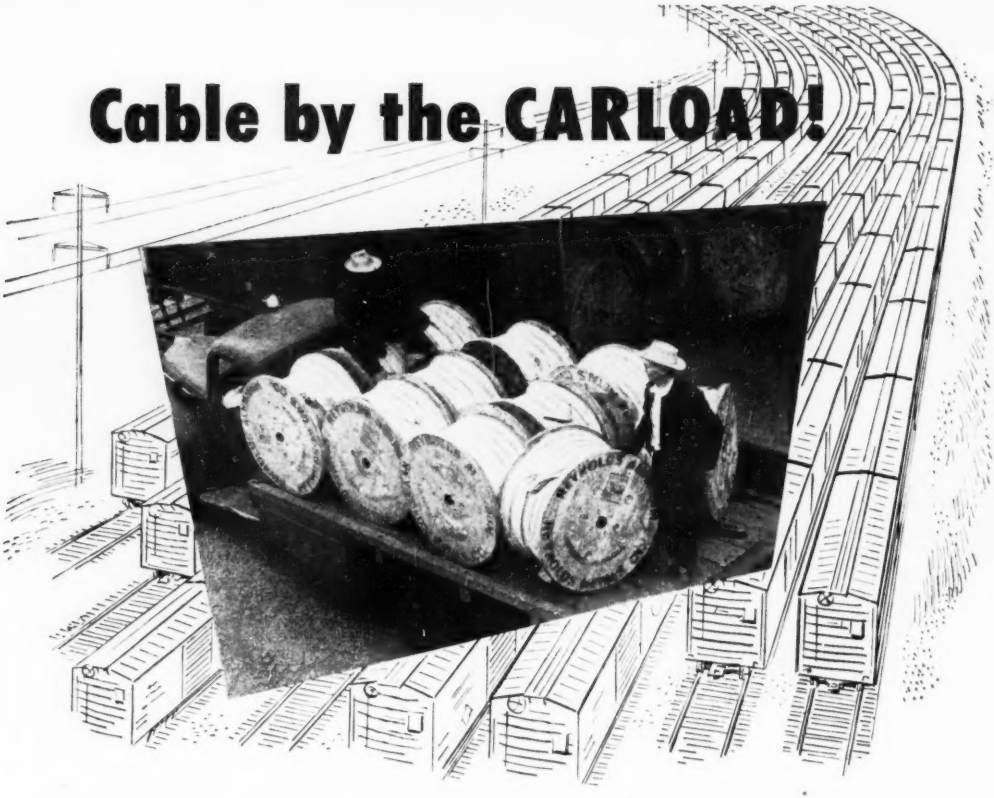
Price: Type 1530-A Microflash — **$600.00** plus current Federal tax.

GENERAL RADIO COMPANY

Cambridge 39, Massachusetts

90 West St., New York 6 920 S. Michigan Ave., Chicago 5 1000 N. Seward St., Los Angeles 38

Cable by the CARLOAD!



Reynolds steps up ACSR deliveries weekly—is now prepared to quote on your requirements—for early delivery . . !

YES, you can add a new name to your suppliers' list for ACSR. Reynolds is in the aluminum cable business—in a big way, permanently.

Starting from scratch just six months ago, today Reynolds has its aluminum cable program under full swing. New aluminum capacity has been allocated specifically to this product to insure continuous, volume production. Millions of feet of ACSR from our mills are already in the field and shipments are being made daily to all parts of the nation.

ACSR offers you substantial savings over copper—and Reynolds offers you the best in ACSR at no extra cost plus firm delivery schedules. Call the nearest Reynolds field office, listed under "Aluminum" in your classified telephone directory. Or write direct for prices and complete information.

REYNOLDS METALS COMPANY • Louisville 1, Kentucky

REYNOLDS *Lifetime* ALUMINUM

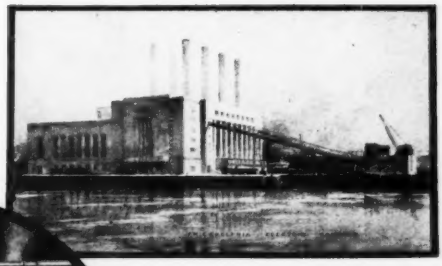
CONSIDER ALUMINUM—CONSULT REYNOLDS—THE COMPLETE ALUMINUM SERVICE

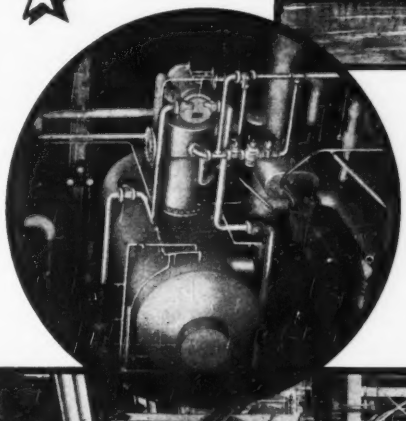
★FAITH IN THE FUTURE★

THE great Philadelphia Electric Company's faith in the future of America and of the important section of America served by its plants, is exemplified in the newest link in its chain of generating stations, the Southwark Station at Oregon and Delaware Avenues, Philadelphia.

Part of the equipment of this great station will be four Cochrane Deaerators.

Selection of Cochrane water conditioning equipment in the far-seeing plans of companies like this all over America, is gratifying evidence not only of faith in the future of America, but in equipment bearing the name Cochrane.





(ABOVE) *Architect's drawing of completed Southwark Generating Station. Design by Philadelphia Electric Engineering Dept., Paul P. Cret Associates, consultants. General contractor, United Engineers & Constructors, Inc.*

(LEFT) *Close-up of one of the Cochrane Deaerators.*

(BELOW) *General view of feedwater heating system with completed Cochrane Deaerator in lower right, with second unit circled in background. Two other units are not visible in this view.*

COCHRANE CORPORATION 86 YEARS OF SERVICE 1863 • 1949

COCHRANE

COCHRANE CORPORATION, 3146 N. 17TH STREET, PHILADELPHIA 32, PA.

MALLORY PLATINUM-ALLOY CONTACTS

Serve in That Trouble-Free Thermostat on the Wall

Almost endless are the hidden tasks performed by different types of Mallory Contacts for products that make life easier and pleasanter. In the mechanism of the thermostatic heat control, for example, you'll find Mallory Platinum-Alloy Contacts doing their job with famous Mallory dependability and precision.

Mallory Platinum—alloyed for added strength, resistance to sticking, and hardness—makes a superb contact material where a high melting point, resistance to corrosion and oxidation, and retention of low contact resistance over long periods are required. Wherever a platinum alloy is needed, a Mallory Elkonium* contact material—produced under rigid controls—is available.

What's Your Problem?

You'll find Mallory Contacts in automotive voltage regulators—in electric business machines—in giant power plant circuit breakers—everywhere! Mallory has designed so many types of contacts that even if you have an unusual problem, chances are a standard Mallory contact will solve it. If not—Mallory engineers are prepared to develop the precise one for you. Consult them now.

For all kinds of contact materials and service, you can't beat Mallory as a dependable, experienced source.

In Canada, made and sold by Johnson, Matthey & Mallory, Ltd., 110 Industry St., Toronto 15, Ontario

Electrical Contacts and Contact Assemblies

P. R. MALLORY & CO. Inc.

MALLORY

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

SERVING INDUSTRY WITH

Capacitors — Rectifiers
Contacts — Switches
Controls — Vibrators
Power Supplies
Resistance Welding Materials

*Reg. U.S. Pat. Off.

PUBLIC UTILITIES:

Dollars Are Important to You

Dollars saved are dollars earned. So why shouldn't you save every dollar you can . . . on *delivery* costs? Dodge "*Job-Rated*" trucks are built to do just *that*.

They're priced with the lowest. They're built *to fit* your particular hauling needs. They stay *out* of the repair shop and *on* the job . . . saving money every mile you drive them.

For example, your Dodge truck will have the right one of 7 "*Job-Rated*" truck engines. You will pay only for the power you need . . . on *your* job.

Your Dodge will have the right clutch, transmission, rear axle, and every other unit . . . "*Job-Rated*" for maximum dependability; minimum upkeep expense.

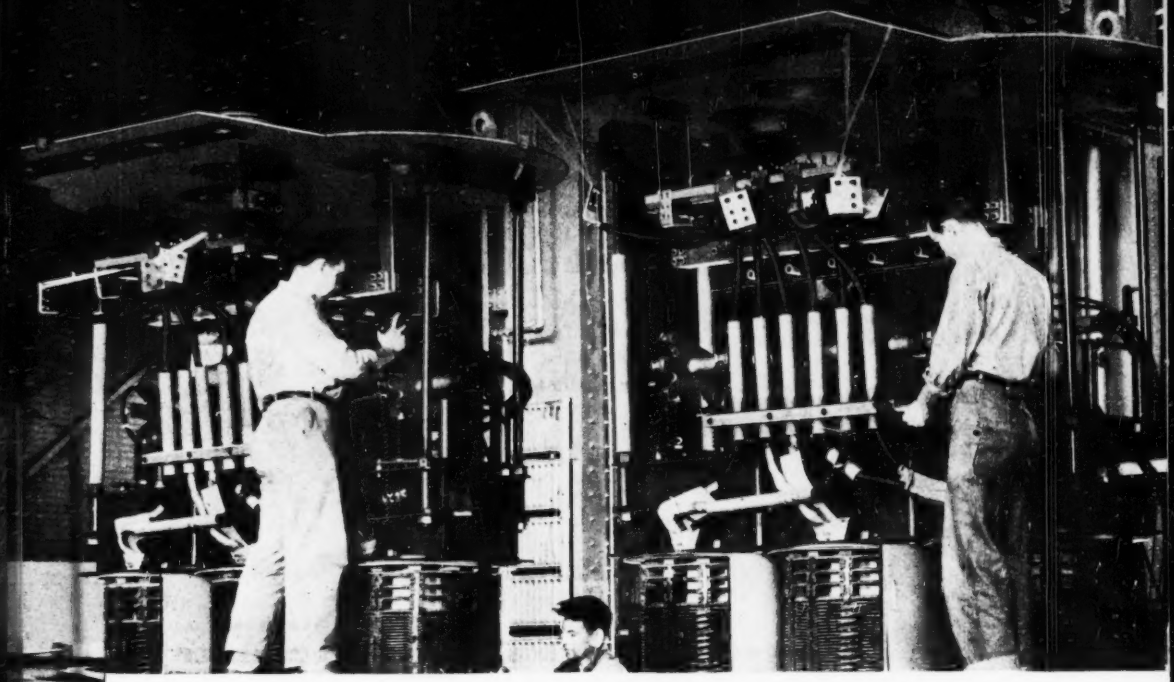
So, if dollars still count in *your* business, see your Dodge dealer. Ask him to recommend the right "*Job-Rated*" truck for your business. Remember . . . *only* Dodge builds "*Job-Rated*" trucks.

Illustrated is the 4-wheel-drive Dodge "Power-Wagon" . . . the truck that needs no roads!

For the good of your business—

Switch to DODGE "Job-Rated" TRUCKS

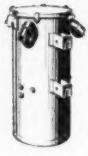
Allis-Chalmers Builds for Electric Utility Progress



New Methods Help Build Better Transformers

IN 1928 . . .

Allis-Chalmers pioneered the use of stud bushings in distribution transformers, now standard in industry.

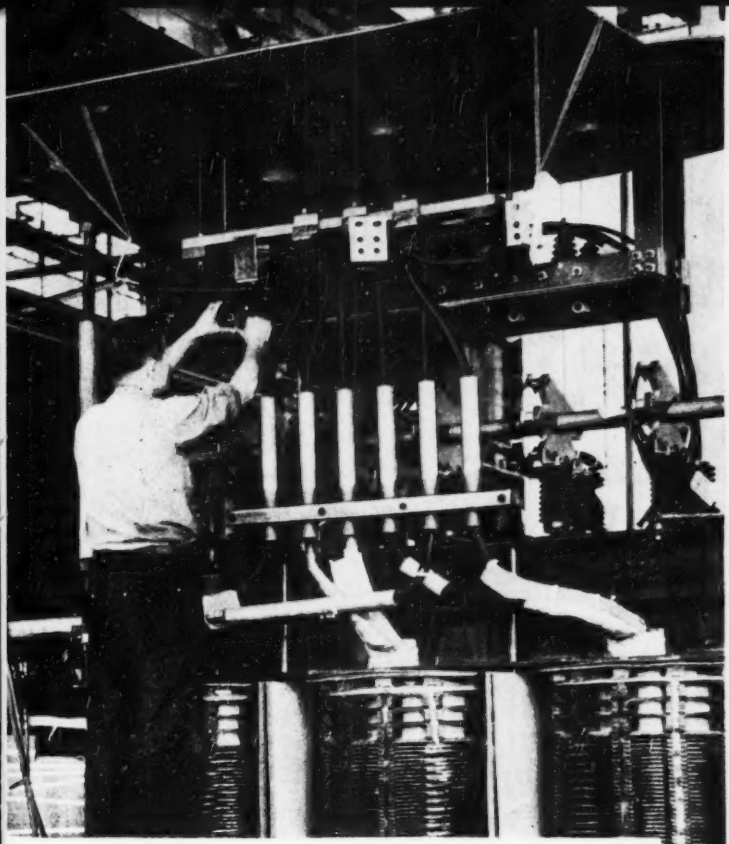


TODAY . . .

New, Bent Contour high voltage bushing is announced by A-C; reduces transformer size, eliminates bushing pockets.

ALLIS

Pioneers in Power and



New A-C Pittsburgh Works Facilities Mean Improved Transformers for Utility Lines

ABOVE YOU SEE finishing touches being put to core and coil assemblies of future A-C power transformers . . . transformers that are going to give added years of dependable service.

Improved facilities like those at right are good reasons why. They're part of a huge program recently completed to speed up deliveries and better the performance of transformers ranging from small instrument to large power!

Specific quality advances resulting from this program include . . . more uniform electrical core steel characteristics . . . extended use of anti-corrosion surface protection . . . more uniform and accurate tank construction.

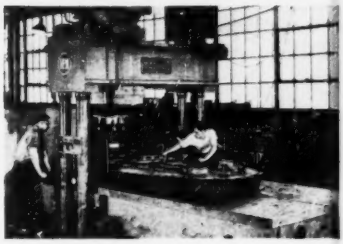
To discover how these improvements can mean better transformers for *your* lines, have your nearby A-C representative call and discuss them in greater detail. Or write direct.

A-2743

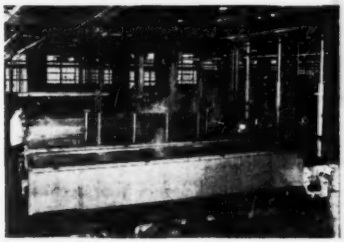
ALLIS-CHALMERS, 932A SO. 70 ST.
MILWAUKEE, WIS.

NEW CORE STEEL coating machine uniformly applies insulation to laminations . . . gives results superior to those obtained with flash finishes.

NEW ELECTRIC ANNEALING FURNACES permit closer control in annealing electrical core steel . . . greater uniformity of steel characteristics.



HUGE 400-TON capacity hydraulic press domes tank covers and handles other fabricating operations with high degree of accuracy . . . another step toward higher, more uniform quality.

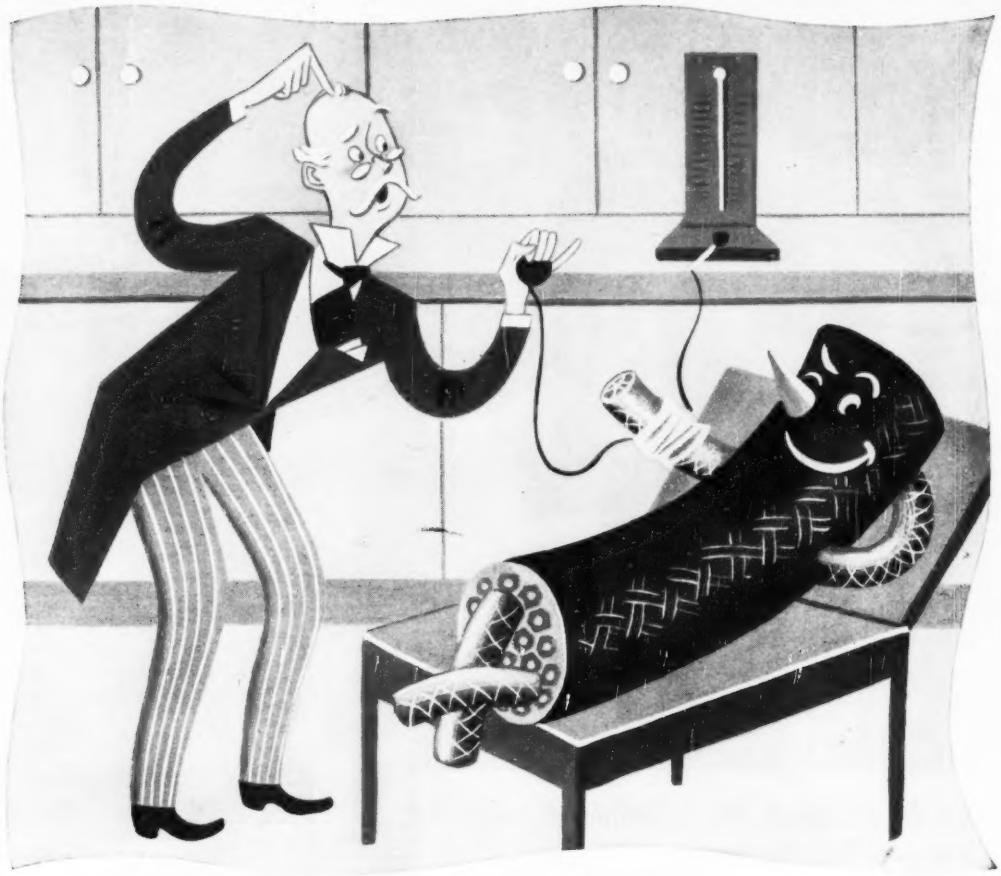


EXTRA PROTECTION against the deteriorating effects of salt fog, chemical dust and other corrosive atmospheres is made possible through 5-step Bonderizing process . . . now extended to include all transformer cooling radiators.

CHALMERS

Electrical Equipment from Generation through Utilization

A-C ALLIS-CHALMERS



How to stump a doctor (IN ONE ACT) •••

Doctor: Name?

Seymour: Seymour Kerite.

Doctor: Age?

Seymour: 95.

Doctor: Er, would you repeat that, please. For a second I thought you said 95, ha-ha.

Seymour: I did.

Doctor: Good gracious, you must be about ready to cash in your chips! Here, lie down while I take your blood pressure. Hmmmm. Ahem. Ahhh, yes. Remarkable!

Seymour: The verdict, doc?

Doctor: Unbelievable! Why, you're in perfect condition. Lively, healthy, and vigorous. How in the world do you do it?

Seymour: You see, doc, it's like this. For nearly a century I've been busy keeping folks satisfied—supplying them with cable insulation that stands up no matter what, lasts a long, long time at a low, low cost per year. And in spite of the fact that many new kinds of insulation are available today, more people want Kerite than ever before — keeping me busier and busier. I *have* to stay young, doc, to keep these folks happy.

Doctor: Very unusual, yes, very. Old in experience, young in spirit. Hmmmm, interesting case.

Seymour: Your prognosis, doc?

Doctor: Mr. Kerite, this examination leads me to believe that you will stay young as long as the electrical industry needs cable insulation with long life and low cost per year.

Seymour: Those are my plans, doc!

The Kerite Company, 30 Church St., New York 7, N. Y.

Kerite Insulation—
Your Cable's Best Life Insurance

DAYS KERITE

KERITE CABLE

A Municipal Stands and Fights

THE PLACE of municipal utility operations in the national power scene may be changing.

So far, as strong backers of the American Public Power Association, municipals have been contributing materially to the promotion of public power. As preference customers in the distribution of energy from federal projects they provide a huge outlet. Well managed in most instances, they are perhaps good examples of efficiency in a socialized industry.

But municipals have strong personalities of their own, which resent management from without. Setting their own rates and planning their own programs are still prerogatives which they justifiably guard jealously. Individually they are not opposed to the private utility industry. They can and do work closely on matters of common interest.

Effectively presenting this attitude was C. A. Erdahl, Commissioner of Department of Public Utilities of Tacoma, Wash. Appearing before the subcommittee of the Senate Committee on Appropriations studying the Bonneville construction program for fiscal 1950, Erdahl stated bluntly that "the City of Tacoma's plans for its own new generating capacity have been blocked by the interference of federal agencies, chiefly within the Interior Department." He also presented "the city's protest against an attitude which disregards local public and private utility rights within the area served by the Bonneville Power Administration."

Following these broad charges, Erdahl went further in pointing out that the issue was not a single instance of the City of Tacoma's being blocked in its Cowlitz River project but that "there is a pattern to the policies of the bureaus which have been applied by federal authority to block projects proposed by private utilities on the Deschutes River in Oregon, and the Roanoke River in Virginia."

There we find a common ground upon which the mutual interests of survival and the community of related activities provide a solid tie. It is the danger of arbitrary decisions of a bureaucracy overpowering the small units of an industry.

Opposition to development of the Columbia River basin or other projects of the federal government is not involved in this fundamental problem. The municipals like the private companies stand ready to purchase the power as it becomes available. The element involved here is that the municipals are being put in the same class as private utilities in the eyes of the Interior Department.

The City of Tacoma could be stopped from developing its Cowlitz River project, required to supply needed capacity, if it is found that some prior federal plans takes precedence. The Roanoke River case will perhaps settle the question as to whether approval by Congress of a War Department plan of river development precludes installations other than by the federal government.

Perhaps the time is not far away when the municipals will find that their interests will best be served by the maintenance of individual freedom of action. They too may decide, in the words of C. E. Wilson, that "this is a good place to stand and fight."

Diesel Economy

Small municipals and industrials usually are confronted with the disadvantages of size when they generate their own power because it just costs less per kwhr to build and operate the larger plants. There is hardly a clearer example of this simple economic principle than the data published in comprehensive detail each year by the ASME Subcommittee on Oil Engine Power Costs. The work has gone on for 20 years without interruption, and the number of plants has always been considerably more than 100. There is no other comparable source of data about diesel plant operating costs and operating characteristics.

Thus the data for 1947 embraced 117 plants ranging in size from 140 to 14,000 kw. It is not surprising to note that for plant and engine running capacity factors upward of 50% the great majority of fuel-diesel stations show fuel economies between 10 and 15 kwhr per gallon of fuel oil. Fuel oil cost appears to have averaged near 7.5¢ per gal. Attendance, superintendence, repairs, supplies, lubricating oil, cooling water, etc., bring the sum total of production cost to as low as 6.83 mills per net kwhr for one of the best entries, but the general average (excluding three very low plant-factor entries) is practically 13 mills. Small municipals with production costs at this level—to say nothing of the investment carrying charges—naturally have difficulty attracting industrial loads at rates based upon such inevitable costs.

The ASME annual data are extremely valuable in throwing light on what can be achieved with small generating plants. The committee is now in the process of collecting and compiling the 1948 data. It should be accorded assistance in keeping the tabulation as accurate, as representative, and as comprehensive as it has been over the years.

This Problem Deserves an Answer

JUST HOW much current can a working overhead line conductor carry before the resulting heat will anneal the copper and cause a drop in tensile strength that will shorten its economic life? Knowing the answer to this question, what limiting conditions of loading are to be specified in defining the short-time emergency rating of overhead lines?

Until these points are established no engineer can tell management what cycle of normal and emergency line loading will damage conductors beyond the economic limit. Without this answer management, in turn, cannot work its vast investment in overhead conductors to the most efficient point.

Before the war loss of tensile strength and the resulting shortening of economic conductor life was seldom a factor influencing permissible loading. Voltage drop and loss-cost economics governed normal loading then just as it does today. For emergencies there was ample reserve in the existing lines to handle any situation that might arise, thanks to the provision made by earlier designers for load growth.

Today conditions are different. Much of the reserve margin in existing overhead conductors has been absorbed by burgeoning loads. Meanwhile, as excess current carrying capacity margins dwindled and management accepted the modern trend toward making investment work harder, there has been a growing reluctance to replace conductors merely to avoid overloading them during short-time emergency periods.

Engineers are being asked: "How much inherent short-time emergency overload capacity is there in a line conductor? What peak load and what duration will cause a 10% loss of tensile strength in a given size wire? How much will such a loss of strength shorten the life of the conductor? At what rate is it economical to use up this allowable margin before replacement?

Nobody knows the complete answer to these questions. Many methods of calculating current ratings and some data on annealing have been published. What is needed now is industry agreement on the sufficiency of the data and upon the standard reference conditions. An industry committee, comprising both users and suppliers, should be formed to examine the entire question of the characteristics and the ratings of overhead line conductors and to recommend suitable bases for the calculation of standard current ratings.

This problem urgently needs solution!

They Don't Know the Words

Most people like to sing. But most people make only feeble attempts at it. Not because they don't try. They do try—and often are pretty trying—particularly when the refreshments have been liberal and the song leader exhorts the throng to harmony while the ice melts around the first course fruit cup or shrimp cocktail. They start out in full-throated chorus, "Down by the old mill stream, where I first met you," but by the time "eyes of blue" are reached the volume has dwindled and only a few survive to the end of the verse. They all know the tune, but most of them have forgotten the words. And some don't follow the tune too well.

Although the comment applies to business generally, we think specifically of power company people in this connection. They know the tune of private enterprise because they live by it. Their jobs, their livelihoods, depend on it. But they don't know the words that go with the tune. Many of the younger generation never learned the words; the older ones have forgotten them. There is a song of freedom in which all men would join. But after a few bars they bog down. They feel the tune but the words are lacking. How, then, can they sing? They must be taught the words. If power company folks are to sing private enterprise, they must be given the words to go with the tune of freedom.

The Electrical Week

To improve their safety records utilities must improve or strengthen the attitudes of their employees. This was the dominant factor brought out at a seminar for utility safety men conducted recently by Ebasco Services, Inc. and New York University . . . President Truman is not likely to get Congressional approval for much of his 11-point program for stabilizing the nation's economy. Tax reductions will be slight. But the President will hold out for deficit spending to keep the country "prosperous" . . . Because of the July 4 holiday, output last week dropped below 5 billion kwhr for the first time since a year ago, but the total was still 4.7% higher.

Senate Public Works Committeemen will head for the Pacific Northwest and local hearings on the proposed Columbia Valley Authority when Congress adjourns.

The Central Trades and Labor Union, AFL, has voted to knock out of its list of aims and purposes the section reading "To bring about public ownership of all public utilities." John I. Rollings, executive secretary, said the decision to eliminate the statement, which has been in the platform for years, had "no special significance." He said the labor group had never made any strenuous efforts to bring about public ownership of utilities.

The Idaho Supreme Court has upheld a state law making it a criminal offense to picket in connection with a secondary boycott. The CIO is taking the case to the U. S. Supreme Court for its telephone union, which was on strike against Western Electric.

Look for new clashes between the Interior Department and Federal Power Commission, this time over the regulation of natural gas. Interior is not yet ready to lower the boom, but Department officials hint they have made quiet studies that indicate FPC's activities are retarding development of the nation's gas resources.

Since V-J Day, the Bell System has added 10 million telephones to its lines. It took 45 years to get the first 10 million installed. There are now 32 million phones in service.

A utility man from the Netherlands on a recent visit to this country paid high tribute to Walker Cisler of the Detroit Edison Co. When in Europe for the government after the war, he suggested to the Dutch that they convert the Rotterdam power plant to burn oil instead of coal, which was practically unobtainable. The change made available the power needed for reconstruction.

After two months of the dock strike, Honolulu appliance dealers report sales off from 40 to 90%. Cause is not shortages of appliances, but "strike psychology" that has stopped people from buying. Dealers are effecting economies by laying off employees, reducing working hours, and cutting wages.

President Truman cracked the whip of Administration loyalty to rally cabinet and sub-cabinet officials behind his Columbia Valley Administration (Authority) proposal. That's why Agriculture Secretary Brannan, Army Secretary Gray, and NSRB Consultant Ed Falck testified on behalf of CVA before the House Public Works Committee.

Congress will turn federal development of California's American River over to the Bureau of Reclamation. The Army Engineers will complete Folsom Dam, but Reclamation will operate it. Development of the American will become part of the Central Valley project.

Notes From The News

New York Public Service Commission has obtained a stay until July 19 of an Appellate Division ruling which set aside a PSC order for a temporary cut in Consolidated Edison Co electric rates of $21.5 million yearly. On that date the court will hear an application for continuance of the stay pending argument on an appeal, expected in the fall term . . . Shareholders have decided to accept a Quebec Hydro-Electric Commission offer under which the 45-year-old Canadian Light & Power Co will be wound up and its plant at St. Timothee, Que., scrapped. Pres James Wilson told stockholders they would realize "something over $25 a share" from the offer . . . Murfreesboro, Tenn., will take over the Middle Tennessee Electric Membership Corp's building for use as a city hall. The co-op will build a new $160,000 headquarters.

Private utilities in North Carolina have been invited by Gov Kerr Scott to provide the state with a program to develop more hydroelectric projects . . . An explosion and fire in the basement of the Crisp County Power Co powerhouse near Albany, Ga., killed one man, seriously

Continued on following page

50-TON SPEED RING for 45,000-kw turbine at the Merwin hydro project of Pacific Power & Light Co is being moved to its final location. New unit will double peak output of the Lewis River plant in southwestern Washington. It is to be ready in December

injured three others, and caused some disruption of electric service. The fire apparently originated at the switchboard and spread through barrels of oil stored in the basement . . . A $10,000 judgment against Kentucky Utilities Co in the death of a 14-year-old boy has been set aside by the Court of Appeals. The boy, killed when he climbed a power-line tower and touched a high-tension wire, was held old enough to be "capable of being contributorily negligent." . . . Pennsylvania Power & Light will provide power for the Emmaus, Pa., water works to prevent a possible water shortage. One of the two diesel engines at the pumping station is out of order, and the other is well worn.

Construction:

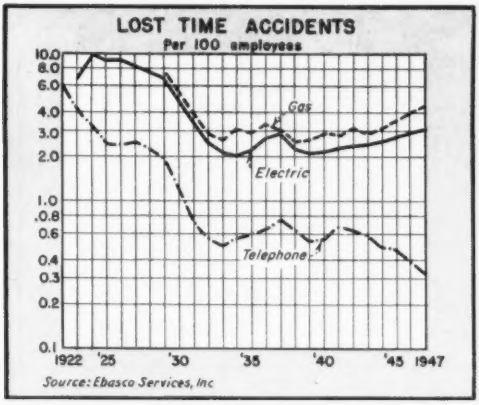
Addition of an 11,500-kw unit, second phase of a $13.5-million expansion program, has stepped generating capacity of Central Arizona Light & Power Co's Phoenix steam plant up to 85,500 kw. Output still is short of demand, which hit 124,110 kw, a new summer peak, the day the new unit went onto the line. A 66,000-kw unit will be in service by May, 1950 . . . The longest underwater power cables in western Canada are being laid by British Columbia Electric Railway Co under Howe Sound in a $75,000 project to bring mainland power to Bowen Island, resort near Vancouver, B. C. Two 12-kv cables will stretch 17,000 ft between Garrow Bay, West Vancouver, and Snug Cove, Bowen Island.

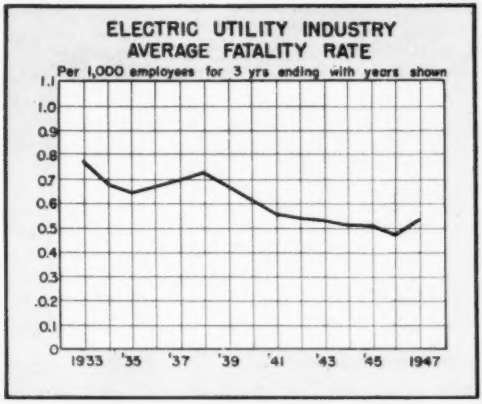
Pennsylvania Power Co, Ohio Edison Co subsidiary, has broken ground for an $11.5-million addition to its New Castle plant which will double present 88,000-kw capacity . . . Construction is expected to begin within six or nine months on a $26-million Union Electric Co of Missouri steam generating plant which may eventually become the largest unit in the utility's system. SEC has approved a plan whereby Union Electric will acquire the West Kentucky Coal Co's Poplar Ridge mine at Sturgis, Ky., thus assuring an adequate and economical coal supply . . . A second 56,000-kw generator has been put into operation at the Montana Power Co's Kerr hydro plant, bringing plant output up to 112,000 kw and the company's total installed capacity to 500,000 kw . . . Pennsylvania Power & Light Co is going ahead with its 3½-year, $75-million construction program as a result of a survey showing signs of stabilization at present levels in a 26-county region of eastern and central Pennsylvania.

Financial:

Commonwealth & Southern's amended dissolution plan was approved by a federal district court in the first important utility dissolution opinion since the pattern-setting Engineers Public Service Co ruling. The SEC-approved plan calls for delivery probably Oct 1, of 2.8 shares of Consumers Power Co common, .55 share of Central Illinois Light Co common, and $1 in cash for each share of Commonwealth preferred and .35 share of Southern Co common and .06 share of Ohio Edison Co common for each share of Commonwealth common . . . A semi-annual dividend on common of 35c a share, 10c above previous half-yearly payments, has been declared by Citizens Utilities Co. An extra of 3/100 common share for each share held also was voted. Both are payable Aug 20 . . . Illinois Power Co has declared dividends of 66 7/12c a share on its 70c cumulative preferred and 50c a share on common for the period from Apr 19 to Aug 1.

A special meeting of Iowa Southern Utilities Co stockholders has been called for Aug 9 to vote on issuance and sale of $3 million in cumulative preferred stock and on an increase in authorized common stock from 360,000 to 560,000 shares . . . Electric Power & Light Corp has retired its common stock and option warrants to conform to the Public Utility Holding Company Act. Distributions are being made at the rate of 0.351677 common shares of Middle South Utilities, Inc., and 1.319209 common shares of United Gas Corp for each Electric common share, with each warrant treated as 1/3 share of Electric common . . . Common stockholders of Central Illinois Public Service Co subscribed for 169,777 of the 446,000 shares of common stock offered by the company at $14.125 a share. The remainder of the offering was sold through investment bankers.





UPWARD TREND in electric utility industry lost-time accidents and fatalities illustrated above was reversed in 1948. Last year the industry made substantial improvement in severity rate (days lost per 1,000 hours worked), which dropped from 2.39 to 2.11. Fatalities were reduced 10% and frequency rate (number of lost-time injuries per million man hours worked) went down 4%. Electric utilities, with a relatively poor record in severity and frequency of accidents (in 1947 thirty-third in severity and twenty-third in frequency among 40 major industries), are far from matching the communications industry, which has the lowest rates of all

Attitudes Held Key to Safety Record

Psychology of Individual Worker, Especially the Accident-Prone, Blamed for Majority of Accidents by Speakers at Ebasco-NYU Safety Seminar

NEW ATTITUDES—not new mechanical devices—hold the key to an improved electric utility safety record.

For example, a group of utility safety men were told recently, the individual worker appears to be responsible for about 83% of all industrial accidents. Principally it's the worker's attitude toward his job. And a tiny group of accident-prone employees dominates this startling record. You find this true in traffic safety—a study of 5,000 Connecticut drivers showed that 6% of them contributed 72% of the accidents—and it seems to be confirmed by research on industrial accidents.

That, says Dr Dawson F. Dean, personnel director for American Home Products, is why the accident-prone employee is important to electric utilities. People have been talking about the accident-prone for years, but Dr Dean has come up with his personality profile, based on medical research on fracture cases. Here's how he sketched him for a seminar in public utility safety just concluded by Ebasco Services, Inc, in conjunction with New York University:

The accident-prone employee will show a history of many childhood accidents—falls, cuts, and fractures. He's impulsive, particularly under stress. He's unstable, educationally and vocationally—tending not to finish courses of study and to change jobs frequently. He'll walk out on the job when it's hard, particularly if authority is exercised. He'll show an early history of neurotic traits—lying, stealing, truancy, sleep walking. He's adventurous, fatalistic toward illness or injury. He has a marked interest in competitive sports, gambling, machinery.

What does that have to do with electric utilities? The answer was obvious when the Ebasco seminar got down to the cost of utility employee accidents. A recent survey of a number of representative utility companies showed an average annual out-of-pocket cost of $72,731, amounting to approximately 50¢ per $100 of payroll—higher than the combined employer-employee contributions for Social Security benefits—and about $15 per employee. The hidden costs—for lost time, damaged equipment, profit and production losses—probably brought the annual figure to more than $300,000 per company, Ebasco's safety students were told.

In the face of such costs, if for no other reason, accident-prone individuals have no place in dangerous jobs, the seminar group agreed. Dean suggests pre-employment and post-employment screening to keep them out—or get them out—of high-risk jobs. You might ask them to list, in detail, all the accidents they can remember having, and inquire into accidents suffered by their families. For a key to attitudes, ask whether they are usually successful when they take risks and get illustrations.

The seminar concerned a good deal more than accident-happy employees.

Dr Walter A. Cutter, of the NYU Center for Safety Education, conducted sessions in effective speaking and, together with Dr Herbert J. Stack, director of the Center, coached members of the group in effective methods of safety training.

Prof Milton D. Kramer, also of the Center, pointed out that utilities have a peculiar highway safety problem among industrial fleets. The reason: So many of their vehicles are handled by men trained as technicians in anything but driving.

Here again the worker's attitude is paramount. Behind the wheel, your employee is on his own—there's no supervisor at hand to enforce safety rules. Driving skill and reaction tests have less to do with accidents than the driver's attitudes toward highway safety. So Kramer recommended careful selection of drivers where possible, training in highway manners as well as driving techniques—and positive incentives through awards and other recognition. Utility motor vehicle ac-

cident figures imply the need for improvement; they rose during 1947-48 for the second consecutive year. The latest figure: 2.68 per 100,000 miles.

One of the ways the utility safety director can reduce accidents in general is to get his top management excited about the problem. This was the advice of W. T. Rogers, Ebasco safety consultant, who was in charge of the seminar. According to the record, Rogers declared, you find a poor safety mark where you find top management's responsibility delegated and where the executives give lip service rather than real support to their safety directors.

Safety Pays Dividends

High accident rates, he pointed out, lower overall efficiency unnecessarily. They indicate to stockholders that management isn't up to its job. Good safety records and programs pay off, not only in lower costs but in employee relations as well.

"It's one of the remaining common grounds between management and labor," Rogers asserted. "Here they have the same goal."

Safety will help customer relations by cutting claims and service outages, and it will help public relations through favorable publicity and the chance it gives for cooperation with city officials, civic groups, and campaigns. Cost reduction through better safety performance will stimulate new capital investment.

Executives Must Push

Active interest of top management has been a common denominator of the safety programs of companies with such outstanding records as those held by New Orleans Public Service, Detroit Edison, Texas Power & Light, Buffalo Niagara, and Washington Water Power, to name a few, Rogers said. Many of these programs are guided by a safety committee in which executives work closely with a fulltime safety director. Such companies have made safety a staff function, with responsibility in line departments. They gather complete accident reports and use them. They detail job instructions and standards—after thorough job analysis and hazard spotting. And they put safety considerations into general personnel practice—make them factors in initial employment, transfers, and promotions.

The supervisor's attitude will have a lot to do with cutting accidents, Rogers declared. Let the foreman know his safety record will affect his advancement. Give him the best training, the latest safety devices—and *back him up.*

CONSTRUCTION WORK is underway at the South Meadow Plant of the Hartford Electric Light Co, where a 45,000-kw unit is to be ready for operation before 1950. Installation will be at the right, with condenser and turbine unit in the foreground and new boiler behind. Western Massachusetts Electric Co has contracted for 20,000 kw of the new capacity

NLRB Orders Utility to Stop Blocking Unions

Kentucky Utilities Co, Lexington, has been directed to stop interfering with the rights of its employees to organize or join a labor union.

The National Labor Relations Board ordered the utility to cease and desist from:

1. Interrogating its employees about their union membership, leadership, or activities.

2. Soliciting employees to sign letters repudiating the authority of Local Union 181, AFL-International Union of Operating Engineers, or any other labor organization to represent the employees.

3. Prohibiting union solicitation or activity on company premises during non-working hours.

4. Enforcing its non-solicitation rule discriminatorily.

5. Interfering in any other manner with employees in their right to form labor organizations.

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Imperial to Expand Power

The publicly owned Imperial Irrigation District, headquartered at El Centro, Calif., has been authorized by voters in the district to sell a $12.5 million revenue bond issue to finance power expansion. A hydroelectric plant is planned at Pilot Nob on the All-American Canal, near the point where water is diverted into Mexico. If the federal government refuses to release this site, the district would build another unit at its recently expanded steam generating plant at El Centro and a small hydroelectric plant addition at Drops 3 and 4.

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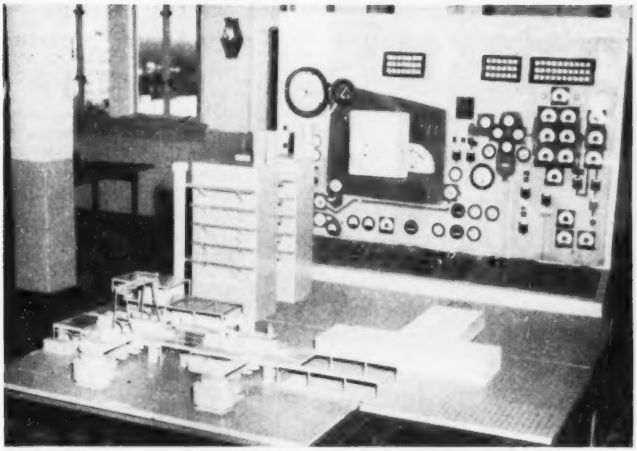
Deadlocks Likely in FPC with Only Four Members

The Federal Power Commission is operating with only four members these days. And it's a situation that could continue for months.

Commissioner Leland Olds' term expired June 22. He was reappointed several days earlier by President Truman, but the Senate failed to act on the nomination. In fact, the Senate Interstate Commerce Committee, to which the nomination was referred for initial discussion, had not even discussed—much less set hearings on—the matter.

Though he remains physically at his desk, Olds cannot participate in FPC decisions until his nomination is confirmed—and that's no certainty either. The remaining members of FPC—Chairman Smith and Commissioners Draper, Wimberly, and Buchanan—may well divide evenly on Commission decisions in the interim. Effect would be, just as it was before the seating of Commissioner Buchanan, to delay final action on deadlocked cases until the confirmation of a fifth member.



MINIATURE of the standardized generating plant adopted by the ALMNO System consisting of the Arkansas Power & Light Co, Louisiana Power & Light Co, Mississippi Power & Light Co, and New Orleans Public Service, Inc. The proposed standard station would be based on two 66,000-kw units, with average cost of about $16 million. The model was based on such capacity. Plans are flexible to include local conditions as well as improvements and innovations. The standardized plant was designed by Ebasco Services engineers

Little of Truman Economic Program Likely to Get by Congress This Year

ONLY SMALL pieces of the President's 11-point program for stabilizing the nation's economy are likely to get through Congress during the present session. Best bet is tax revision—and there may be more of that than the White House wanted.

President Truman requested repeal of a single tax—the excise on domestic freight—in his midyear economic report. But the Senate Finance Committee already had approved removal of several wartime excise taxes. Further Congressional action, now imminent, is expected to open the gates to the ever-present flood of demands for repeal of virtually all excises.

Outcome almost certainly will be repealers of several business taxes in any legislation adopted by Congress. Such legislation would face almost certain veto, since the President made it clear he wanted no "significant" reduction in tax revenues at this time.

Among the other Truman proposals of interest to the electrical industries, his recommendation for liberalizing tax credits for corporate losses probably would be included in any new tax bill. Extension of the time limit for amortization of Reconstruction Finance Corporation loans to business is popular, but Congress won't act this year.

An increase in the minimum wage, possibly from 40c to 60 or 65c, is a possibility, but not the President's proposed 75c per hour. Federal aid to states and local governments in planning and acquiring sites for "useful" public works probably will run afoul of Congressional plans for adjournment.

Particularly interesting was the President's justification for anticipated deficite financing of the federal government. Conceding that major tax increases would have an adverse effect on national income and purchasing power, he still refused to consider reduction of federal spending for resource development and social programs.

"The sound objective of government policy is to contribute toward the maximum use of our resources, not to contribute toward having them lie idle and unused," the President said. With shortages of manpower and materials eased, he added, "it would be inconsistent with sound fiscal policy and common sense to make these programs smaller. "There are economic and social deficits that would be far more serious than a temporary deficit in the federal budget."

At the same time the President saw no need "for an immediate and sweeping expansion of public works." But the government should ready plans for new public works as a "precautionary" step in case the business downturn should become more serious. The federal civil works budget of some $3 billion for fiscal 1950, plus approximately equal expenditures in 1951 and 1952 "at construction rates now planned," should help maintain purchasing power and stimulate "investment opportunities."

The report of the President's Council of Economic Advisors, on which Mr Truman based his findings, contained a special appeal to public utilities. In seeking rate increases, the Council urged, the utilities should give consideration to the effects thereof on the national economy.

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Michigan Law Abandons Forced Utility Arbitration

Compulsory arbitration of labor disputes in utilities is eliminated in a modified Bonine-Tripp Labor Act passed by the Michigan Legislature.

The new formula, replacing one which was shadowed by constitutional objections, provides that the State Labor Mediation Board will intervene in any utility dispute and will propose mediation. If the parties refuse, the case will be submitted by the governor to a fact-finding panel. Strike action, meanwhile, will be held in abeyance.

The findings of the panel will then be used as the basis of a new mediation attempt by the state board. That failing, the board will again propose voluntary arbitration. If this is refused, a strike vote will be taken.

A strike vote in utilities or any other bargaining unit becomes valid if it is approved by a majority of all voters. In the original law, the majority had to be from among the entire bargaining unit.

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Barnes Named to PUC

Irston R. Barnes, Hamden, has been appointed to the Connecticut Public Utilities Commission for a six-year term starting July 1. He succeeds Eugene S. Loughlin, Greenwich. Charles W. Knapp, West Hartford, was named to fill the unexpired term of Frederick H. Holbrook ending July 1, 1955.

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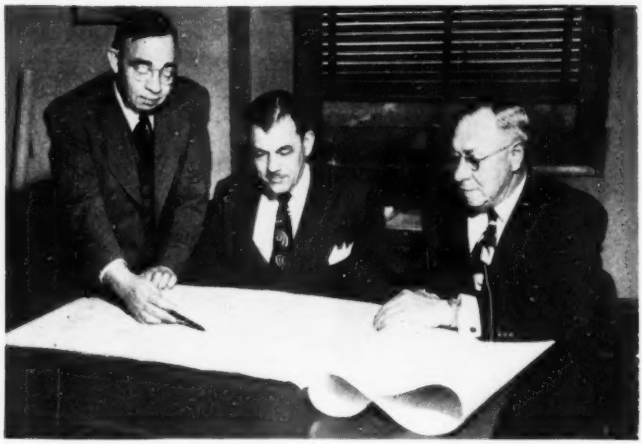
To Add Unit at Sarasota

Florida Power & Light Co plans to more than double capacity of its three-year-old Sarasota generating plant, from 18,000 to 38,000 kw.



C. MYRON LYTLE, center, new manager of engineering for Kansas City Power & Light Co, checks over a set of plans for some construction jobs. At left is J. Clark Davis, ranking assistant manager, and Fred G. Freshman, assistant manager, is at the right

Kansas City P&L Forms Engineering Department

Kansas City Power & Light Co has organized an engineering department to handle its $52 million expansion program. The move was forced by the dissolution of the United Light & Railways Co, parent of the utility. The service company's engineering department at Davenport, Iowa, is being discontinued.

Heading the new department, as manager of engineering, is C. Myron Lytle, formerly chief engineer of transmission and distribution. He will report directly to President Harry B. Munsell. Lytle's former assistant, J. Clark Davis, will become ranking assistant manager of engineering, in charge of electrical transmission and distribution. Fred G. Freshman, former head of the KCP&L drafting division, is also designated assistant manager of engineering, in charge of mechanical and structural engineering. He will continue to supervise the firm's drafting.

Two additional assistant managers will be named later. One will handle production engineering. The other will be in charge of the utility's engineering activities in outlying districts and its property at Mason City, Iowa.

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Add Niagara Hudson Unit

Ground has been broken at Oswego, N. Y., for an 80,000-kw addition to the Niagara Hudson System's Oswego steam-electric generating station, to cost more than $10 million. The unit, which will increase the station's capacity to 320,000 kw, is one of five steam-electric projects scheduled for completion by 1951. One of the largest power developments in the country, the entire program will add about 500,000 kw to the system's installed capacity.

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Wage Hike From 4.7-6% For Three Companies

Wage boosts ranging from 4.7 to 6% were agreed to by electric utilities recently.

Almost 1,000 Albany employees of the New York Power & Light Corp got the 6% boost under the first contract the company has made with the International Brotherhood of Electrical Workers. It came as a result of system-wide bargaining with the Niagara-Hudson system. It was reported, though neither side would confirm it, that a union shop provision, pending an NLRB election, was agreed to.

Public Service Co of Indiana granted a blanket 5% increase for hourly workers, retroactive to May 1. Certain workers also get 4.5 cents per hour to eliminate inequities. The wage pact affects 1,300 employees in 70 counties and is estimated to cost $325,000 yearly.

Toledo Edison employees covered by a contract with the Office Employees Union-AFL won a flat 4.7% boost.

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Iowa Franchise Renewed

Early, Ia., voters have approved a 25-year renewal of Iowa Public Service Co's 25-year electric franchise.

Union Electric Reenacts Coffin Award Ceremony

Capitalizing on its winning of the Coffin Award, Union Electric Co of Missouri recently reenacted the presentation before the St. Louis Chamber of Commerce. The award was first presented to the company at the annual convention of Edison Electric Institute.

The utility won the General-Electric-sponsored award for its community relations program and especially for its campaign to eliminate fly ash precipitation (EW, June 4, p 55).

Charles E. Wilson, GE president and principal speaker, asserted that this occasion "presents one more golden opportunity to sound a call to arms in a cause which must forever be our first cause—the aggressive maintenance of the American way of business life—I believe sincerely that this cause stands today in danger and that every one of us must mobilize and activate his personal forces of economic strength to turn back the enemy."

He used the nationalization of industry in England as an example of what can happen here. "We cannot fight it (nationalization) with words alone, but we can fight it with actions. This is a broad front, like any front, and although a few feet of it such as you or I can usually see across our desks does not seem to amount to much; yet every foot of it is vital to our continued existence. Breakthroughs are fatal."

Pointing out that the electric power business is one section of private enterprise that is definitely under attack by nationalization groups, Wilson asserted, "We cannot meet this attack, I am convinced, with resentment and righteous hostility, but we can meet it with action. We think this is a good place to stand and fight, by making sure that the electric power industry is ready to expand, finance, and develop new electric generating capacity where it is needed and wanted. We think this is our business, not government business, and it coincides with the tradition of our industry, which is a tradition of action."

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Drops Municipal Plant

Garrett, Ind., will buy all its power from the Indiana & Michigan Electric Co. The City Council authorized the Board of Public Works to sign a contract with the utility after receiving a report that the cost of expanding the municipal plant to meet increased demand would be slightly in excess of $450,000.

ADDITION to Ohio Edison Co's Toronto plant on the Ohio River will house two new 60,000-kw units. First new generator is scheduled for operation in August. Second will be ready for service early next year. They will bring plant capacity to 300,000 kw. Building addition (lighter brick at left) is 148 x 225 ft, stands 144 ft high

FPC's Estimate of New England Hydro Potential 6 Times Council's

FEDERAL POWER Commission estimates of a total of 3,119,000 kw of undeveloped hydroelectric power capacity in New England were revealed this week by Sen Leverett Saltonstall, Massachusetts Republican.

The FPC findings on power resources of the region's streams exceeded by more than six times recent estimates by the New England Council of the total hydro potential. An NEC study group concluded that a total of about 500,000 kw in additional hydroelectric capacity could be produced economically in the area.

The Saltonstall-FPC interchange, instituted last January by the Massachusetts legislator, aroused considerable stir in public power circles. Though FPC responded in February with a lengthy memorandum on New England's hydro potential, Senator Saltonstall refused to divulge the contents of the memo. Public power proponents charged the senator with squelching the report because it contained potential arguments for public power development in New England.

FPC carefully pointed out three major differences between its own and the New England Council's approach to calculating water power resources.

First, NEC apparently summed up the total power capacity of individual projects, while FPC considered integrated development of each stream. Second, NEC calculated only single-purpose power projects, and FPC considered possible multiple-purpose developments, with power, flood control, navigation, and other benefits sharing the development costs. Third, NEC estimated project feasibility on the basis of private financing, while FPC concluded that otherwise marginal projects could be built by the government at lower money cost.

Warning that its estimates covered potential projects requiring considerable additional study to establish their feasibility, FPC set potential water power of the New England states at the following totals: Maine, 1,807,000 kw; New Hampshire, 366,000 kw; Vermont, 476,000 kw; Massachusetts, 160,000 kw; Connecticut, 110,000 kw.

The totals for Maine include 220,000 kw as the potential of the U. S. Passamaquoddy tital power project, now under study by the International Joint Commission.

FPC also disagreed with the New England body on estimates of the area's future power requirements. NEC estimated that New England would need additional generating capacity totaling "about 1,100,000 kw" by 1957. FPC calculated the region's need for addition dependable capacity at 2,135,000 kw by 1957.

Principal differences in calculating these requirements, FPC concluded, involved the following factors:

1. FPC estimated the area's peak load for 1957 at 330,000 kw above the 4,000,000 kw foreseen by NEC.

2. FPC assumed retirement of about 300,000 kw of old thermal generating equipment; NEC made no provision for retirements.

3. FPC figured on greater reserve capacity in 1957, a total of 630,000 kw, as compared to 566,000 kw of reserve allowed by NEC.

St. Lawrence power, when and if developed, would be little help in the face of the area's 1957 requirement, FPC concluded. The U. S. share of this generation is estimated at about 700,000 kw of dependable capacity. New England could scarcely expect more than 100,000 kw, only about 5% of its estimated requirements for 1957.

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Largest U. S. Cooperative, Pedernales, Will Be Split

The nation's largest power co-op, 11-year-old Pedernales Electric Cooperative, Inc, will be divided Aug 1.

Under the plan adopted at the co-op's annual meeting in Austin, Tex., 4,000 subscribers in ten counties will go into a newly organized Central Texas Electrical Cooperative Inc. Central Texas will take over about 40% of Pedernales' 12,000-mile distribution system and $2,064,154 of its indebtedness. Pedernales Co-op, whose assets now are valued at $6 million, will continue to serve 8,000 customers in 11 counties.

Guthrie Taylor, vice-president of the Pedernales board, said the division results largely from financial considerations. Small co-ops can borrow the funds they need with relatively little difficulty while the larger system has more trouble borrowing the larger funds it requires.

•

Interior Tries Again

Interior Department attorneys have dragged a railroad rate proceeding into their fight to prevent utility company development of the Roanoke River. Barred by the Federal Power Commission from formal status as an intervenor in recent hearings on a Roanoke project, the Department has twice appealed for rehearing on the intervention issue. Its latest rehearing appeal was based largely on a recent Supreme Court decision that the federal government might sue itself to obtain a freight rate refund.

NEED FOR ADEQUATE home wiring was shown thousands of visitors to the recent Erie, Pa., Home and Garden Show by this Pennsylvania Electric Co display. Figures of Reddy Kilowatt moved on an endless belt. On hand to answer questions were Grace Osborne, Kenneth Cope and Eugene Fleckenstein, members of Penelec's residential sales department

SEC RULINGS

Kansas Power & Light Co's and its subsidiary, Kansas Electric Power Co's joint declaration, proposing that Kansas Electric merge into Kansas Power, has received withdrawal approval from the commission. (Release No. 9153).

North American Co has been permitted to make stabilization purchases on the New York Stock Exchange in the Wisconsin Electric Power Co 6% preferred capital stock ($100 par) on the date to be set by it, for the opening of bids on 13,494 shares of such stock being offered for sale competitively by North American. Any shares thus acquired will be resold on the Exchange as soon as practicable after consummation of the sale of the 13,494-share block. Divestment of North American's interest in Wisconsin Electric was ordered by the commission in 1942. (Release No. 9164).

Texas Utilities Co has received clearance of the proposed sale of an additional 400,000 shares of its common stock (no par) to its parent, American Power & Light Co, for a cash consideration of $7,000,000. Texas would use the proceeds to liquidate certain short-term bank borrowings to enable it to make an additional $4,000,000 equity investment in its subsidiary, Texas Electric Service Co, and to make an additional $3,000,000 equity investment in its subsidiary, Texas Power & Light Co. (Release No. 9179).

Interstate Power Co's "compromise plan" for distribution of certain escrowed assets has been amended in accordance with the commission's decision of June 7, 1949, and the plan as amended has been approved by the commission. The commission announced that it would file an application with the U. S. District Court in Wilmington seeking approval and enforcement of the amendment plan. The plan was filed by Ogden Corp, Inter-state's parent, and was designed to effect a settlement of the subordination issues regarding the rank and status of Ogden's former holdings in Interstate and to distribute certain escrowed assets consisting of $1,050,637 in cash and 944,961 shares of Interstate's new common stock among Ogden and other holders of Interstate's old debentures and preferred stock. The compromise plan provides in general for the distribution to holders of debenture escrow certificates of 102 shares of the new common and $73.50 in cash for each $1,000 principal amount of certificates held; to holders of Interstate's old preferred stocks, including Ogden, of ½ share of new common and $0.1349 cash for each share of $7 preferred stock and/or $7 preferred escrow certificate, and 45/100 share of new common and $0.1214 cash for each share of $6 preferred stock and/or $6 preferred escrow certificate; and to Ogden as holder of Interstate's formerly outstanding $2,475,000 6% demand note, 122,336 shares of new common and $133,840 cash. (Release No. 9202).

North American Co has been authorized to purchase an additional 367,500 shares of the common stock (no par) of Union Electric Co of Missouri for a cash consideration of $5,000,000. Union Electric would use the funds for its construction program. The commission reserved decision upon the proposal of the North American Co to transfer its stock interest (1,500,000 shares of $5 par common stock) in Missouri Power & Light Co to the Union Electric in exchange for 600,000 additional shares of Union Electric common. (Release No. 9147).

MEETINGS

American Institute of Electrical Engineers
Pacific General Meeting, Fairmont Hotel, San Francisco, Calif., August 23-26; Midwest General Meeting, Netherland Plaza Hotel, Cincinnati, Ohio, October 17-21.

Maryland Utilities Association
Fall Conference, Cavalier Hotel, Virginia Beach, Va., September 9-10.

Rocky Mountain Electrical League
Fall Convention, Stanley Hotel, Estes Park, Colo., September 11-14.

Instrument Society of America
Clinic on Maintenance of Industrial Instruments, Statler Hotel, St. Louis, Mo., September 9-12; Annual Convention, Municipal Auditorium, St. Louis, September 12-16.

★ **Southeastern Electric Exchange**
Engineering and Operating Section, Hotel Roanoke, Va., September 19-20; Accounting Section, Henry Grady Hotel, Atlanta, Ga., September 22-23; Personnel Administration Section, Henry Grady Hotel, Atlanta, Ga., September 23; Sales Conference, Biltmore Hotel, Atlanta, October 26-28.

Illuminating Engineering Society
National Technical Conference, French Lick Springs Hotel, French Lick, Ind., September 19-23.

Pennsylvania Electric Association
Annual Meeting, Benjamin Franklin Hotel, Philadelphia, Pa., September 20-21; Transmission and Distribution Committee, Fort Ligonier Hotel, Ligonier, Pa., October 20-21.

★ **Edison Electric Institute**
Accident Prevention Committee, Robert Treat Hotel, Newark, N. J., September 22-23; Electrical Equipment Committee, Hotel Van Curler, Schenectady, N. Y., October 3-5; Meter and Service Committee, Leland Hotel, Springfield, Ill., October 3-5; Transmission and Distribution Committee, Lord Baltimore Hotel, Baltimore, Md., October 31-November 1.

National Electronics Conference
Edgewater Beach Hotel, Chicago, Ill., September 26-28.

Indiana Electric Association
Annual Convention, French Lick Springs Hotel, French Lick, Ind., September 28-30.

National Television and Electrical Living Show
Second Annual Show, Sponsored by Chicago Electric Association, Chicago Coliseum, September 30-October 9.

National Association of Corrosion Engineers
South Central Region, Adolphus Hotel, Dallas, Tex., October 3-4.

Canadian Electrical Manufacturers Association
Annual Meeting, General Brock Hotel, Niagara Falls, Ont., Canada, October 4-6.

Iowa Utilities Association
Management Conference, Hotel Fort Des Moines, Des Moines, Iowa, October 10-11.

American Society for Testing Materials
First Pacific Area National Meeting, Fairmont Hotel, San Francisco, Calif., October 10-14.

American Standards Association
Annual Meeting, Waldorf-Astoria Hotel, New York, October 11-14.

★ **International Association of Electrical Leagues**
Annual Conference, Hotel Cleveland, Cleveland, Ohio, October 12-15.

★ **Electrochemical Society**
Fall Congress, La Salle Hotel, Chicago, Ill., October 12-15.

National Safety Council
National Safety Congress and Exposition, Stevens, Congress, Morrison, Sherman Hotels and the Palmer House, Chicago, Ill., October 24-28.

National Metal Trades Association
Annual Convention, Palmer House, Chicago, October 26-28.

★ **National Electrical Contractors Association**
Annual Convention, Rice Hotel, Houston, Tex., November 8-11.

★ **National Electrical Manufacturers Association**
Annual Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J., November 14-18.

★ **Refrigeration Equipment Manufacturers Association**
All-Industry Refrigeration and Air Conditioning Exposition, Atlantic City Auditorium, Atlantic City, N. J., November 14-18.

★ Additions this week

Canadian Output Sets Record, Tops 4.1 Billion

With a sudden spurt, output of Canadian central stations rose to 4,150,346,000 kwhr in April to set a new record. The record output put production for the first four months of the year slightly ahead of that for the corresponding period of 1947, the record production year. The previous high for monthly production was set in May (a 31-day month), 1948, with 4,072,973,000 kwhr.

Accompanying the rise in production was a decrease in primary consumption. As a result the 514,054,000 kwhr of secondary power produced was nearly half of the 1,086,770,000 kwhr total for the first third of the year.

The following statistics supplied by the Dominion Bureau of Statistics are in thousands of kilowatt hours:

Period	1949	1948
Four months	15,173,264	14,733,022
Primary	14,086,494	13,779,260
Secondary	1,086,770	953,762
Primary Consumption	13,637,949	13,353,800
Net Exports to U. S.	644,622	517,265
April	4,150,346	3,727,459
Primary	3,636,292	3,426,047
Secondary	514,054	301,412
Primary Consumption	3,517,183	3,318,715
New Exports to U. S.	179,290	153,738
March	3,923,721	3,758,566
Primary	3,713,253	3,572,290
Secondary	210,468	186,276
Primary Consumption	3,601,670	3,466,686
Net Exports to U. S.	164,911	124,758

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Utility Operating Revenues Increased 6.5% in May

Electric operating revenues of the larger privately-owned electric utilities in the United States in May, 1949, were $348,029,000, compared with $326,751,000 in May, 1948, an increase of 6.5%, the Federal Power Commission has announced.

Revenue deductions (including operating expenses, depreciation, and taxes) were $278,350,000, or 5.4% over those of May, 1948.

Gross income, including other utility operating income, amounted to $78,112,000, an increase of 11.1% for the month. Net income was up 11.3% to $55,920,000 from the $50,253,000 reported for May, 1948.

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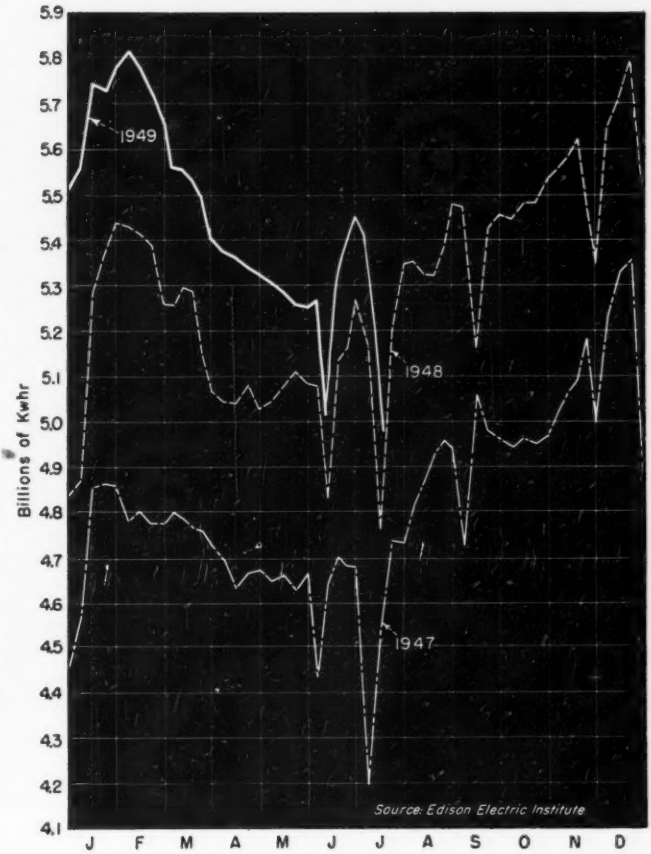
Stops Service to Co-op

The City of Clarksdale, Miss., will stop furnishing power to the Coahoma Electric Power Association because of increased municipal demands and plant repairs. Electricity for the approximately 2,000 rural homes served by the co-op will come from Mississippi Power & Light Co.



Output Percent Change Holds at 4.7

The electric output curve took a sharp drop during the week ended July 9, 1949, which contained the July 4 holiday, according to figures released by the Edison Electric Institute.

The amount of electrical energy distributed totaled 4,982,173,000 kwhr, compared with 5,410,392,000 kwhr during the preceding week.

During the corresponding week last year, ending on July 10, the amount of electrical energy distributed totaled 4,760,316,000 kwhr, this year's figure representing an increase of 4.7%, the same as for the week ended July 2.

A remarkable recovery was shown by the New England States, which reported an increase of 7.8%. Though the region had entered the plus column in mid-June and remained there through the month, for the week ended July 2 it had slipped back to the minus column with a 0.6% decrease. For the third successive week, the Mid-Atlantic States showed a higher decrease, 1.2% for the week ended July 9.

The largest individual gain was shown by the Rocky Mountain group.

Weekly Output, Millions Kwhr

1949	1948	1947
July 9 4,982	July 10 4,760	July 12 4,531
July 2 5,410	July 3 5,166	July 5 4,190
June 25 5,466	June 26 5,257	June 28 4,675
June 18 5,373	June 19 5,159	June 21 4,676
June 11 5,300	June 12 5,132	June 14 4,702
June 4 5,018	June 5 4,845	June 7 4,635
May 28 5,270	May 29 5,076	May 31 4,429
May 21 5,255	May 22 5,085	May 24 4,663
May 14 5,257	May 15 5,109	May 17 4,616
May 7 5,284	May 8 5,087	May 10 4,653
Apr 30 5,304	May 1 5,042	May 3 4,640
Apr 23 5,326	Apr 24 5,027	Apr 26 4,668

Percent Change from Previous Year

	July 9	July 2	June 25
New England	+ 7.8	— 0.6	+ 2.4
Mid-Atlantic	— 1.2	— 0.9	— 0.0
Central Industrial	+ 0.5	+ 0.5	— 1.1
West Central	+ 7.9	+ 6.6	+ 5.7
Southeast	+ 4.9	+ 4.2	+ 1.6
South Central	+14.4	+14.9	+10.1
Rocky Mountain	+15.0	+17.8	+14.3
Pacific Coast	+ 9.1	+13.0	+15.5
Total United States	+ 4.7	+ 4.7	+ 4.0

WASHINGTON COMMENT

WILLIAM B. WHICHARD

WASHINGTON'S summers are notoriously hot and humid, and the 1949 version has been no exception. So it may have been the heat which caused an otherwise inexplicable lapse by Clyde T. Ellis.

Ellis' official title is executive manager of the National Rural Electric Cooperative Association, whose members include a large group of the rural power co-ops financed by the Rural Electrification Administration. But he is better known in Washington as the very able lobbyist for NRECA co-ops and, to only a slightly lesser degree, for all federal power projects. To put it mildly, he is seldom caught unawares by political developments in the electric power field, especially in co-op power.

But there he was last June 6-7, standing before a Senate Appropriations subcommittee and confessing his sheer amazement over the appearance of a co-op group. No less than 110 co-op managers and other officials had come before the subcommittee to testify on budget requests of the Interior Department's Southwestern Power Administration. There were co-op people from six states —Arkansas, Kansas, Louisiana, Missouri, Texas, and Oklahoma—swarming all over the hearing room and overflowing into the corridors. Ellis told the disconcerted senators he was just flabbergasted.

"We did not ask a single one of them to come up here, and I did not know they would be here until I arrived," he testified.

Though most, if not all, the 110 represented co-ops affiliated with NREACA, they did not appear on behalf of his association, Ellis asserted.

"We did not ask them to come up here," he again pointed out. "They came on their own initiative."

This was more than a little incredible to members of the subcommittee and to newsmen familiar with the modus operandi of lobbyist Ellis. Though it served only to heighten the mystery of the 110 "unexpected" witnesses, there was reassurance a few days later that Ellis had recovered his equilibrium and was doing his lobbying in the familiar, orthodox manner. This time, he was rallying support for legislation which would permit REA to make loans for farm telephone service.

In a memo dated June 14 and addressed to managers "of all NRECA systems" Ellis asked:

"Would you like to come in for the Senate hearings on the telephone bill? Would any of your directors like to come in? Can you get any officials of the independent or Farmers' Mutual Telephone companies within your area who are for the bill to come in?

"We need a showing of grass-roots support" for the telephone bill, the memo continued. This same term—"grass-roots support" was applied by Ellis to the 110 "unexpected" SPA witnesses, incidentally.

But this time Ellis would not be taken by surprise—or would he? At any rate, his memo cautioned co-op managers planning to attend the telephone hearings to "wire us collect to that effect, and we'll wire you back the minute we know when you might be heard."

Otherwise, the memo indicated, the appearance—it has not yet come off—is to follow the pattern of the SPA testimony. Ellis particularly seeks numbers.

"You will appreciate, of course," the memo added, "that it is possible for more of us to show up than the committee will agree to hear, but the record would show that we were here waiting and ready to testify, and the effect of the presence of a goodly number of us would be helpful."

Which explains the motive of whoever, if anyone, planned the appearance of the 110 SPA witnesses, only 14 of whom could be heard. But it also makes it tough to explain future "unexpected" NRECA delegations.

TECHNICAL NOTES

ARCHER E. KNOWLTON

System impedance is typically divided 50% up to the distribution transformer and 50% from the transformer primary terminals on. Increase in transformer rating (assuming reduction in reactance impracticable) is a better answer to voltage dips than larger wire.

Defrosting in heat pumps or air-conditioning systems is done most advantageously and economically if (1) the deposit is not allowed to build very thick and (2) no attempt is made to remove it entirely.

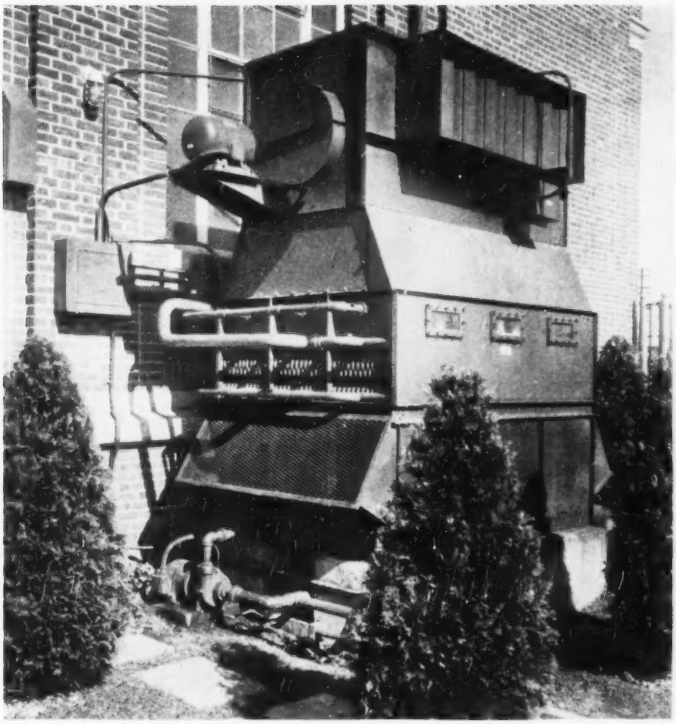
Interconnection of subtransmission to take advantage of load diversity can avoid provision of additional transformer banks, reduce losses and facilitate flexibility.

Foaming is a chemical rather than mechanical phenomenon in a boiler and the corrective for carryover is therefore more effective if chemical rather than mechanical.

Gas recirculation from economizer into the furnace should be a practicable way of controlling superheat temperature at times of light load.

Electrets are wax compounds that manifest magnetic properties. One composition consists of carnauba wax, rosin and beeswax.

Ideal lubricant for many applications should have low resistance to movement parallel to the bearing surface and high resistance to movement perpendicular to the surface. The two viscosities are often attainable.



EVAPORATIVE CONDENSER for cooling refrigerant in yard adjacent to substation building

Maximun Capacity from Urban Substations Through Use of Refrigeration

B. R. NEVINS and E. R. JOLINE
Philadelphia Electric Co
Philadelphia

Air cooling by refrigeration used in nine urban substations on Philadelphia system to maintain constant ambient temperature. Rerating of equipment boosts station capacity from 22,500 kva to 36,000 kva at attractive cost

CONTROL of ambient temperature by refrigeration has successfully avoided investment in several new substations on the system of the Philadelphia Electric Co by making it possible to apply 60% higher ratings to existing distribution circuits in nine urban-type substations where load had outgrown original design capacities.

These nine substations, part of a group of 12 built between 1922 and 1931, are all essentially of the same design, and supply a large part of the industrial and residential electric service in the city of Philadelphia. All available space for distribution circuits had been used. Moreover, expansion by additions to existing buildings was either impractical or impossible in most cases. Several new substations were indicated by the load situation but building sites in the high load density metropolitan areas are expensive and difficult to obtain.

There was a strong incentive, therefore, to find a means of getting more capacity from the existing substations, rather than build new ones. The problem was to find out: (1) How much the distribution circuit capacity of these substations could be increased and (2) how this could be done.

The solution, which will be detailed in this article, was to increase the rat-

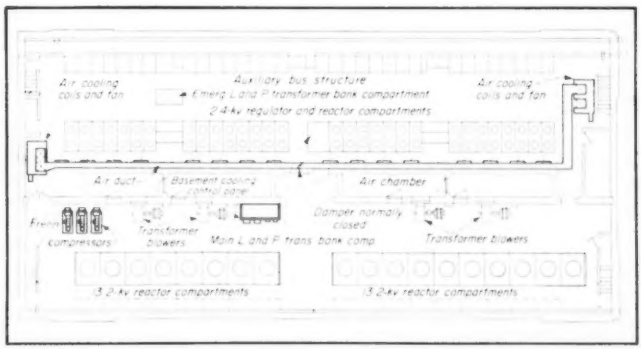
AIR COOLING is used in 2,400-v basement to maintain constant ambient temperature to obtain maximum capacity

ing of individual distribution circuits and install sufficient refrigeration equipment to maintain a low ambient temperature.

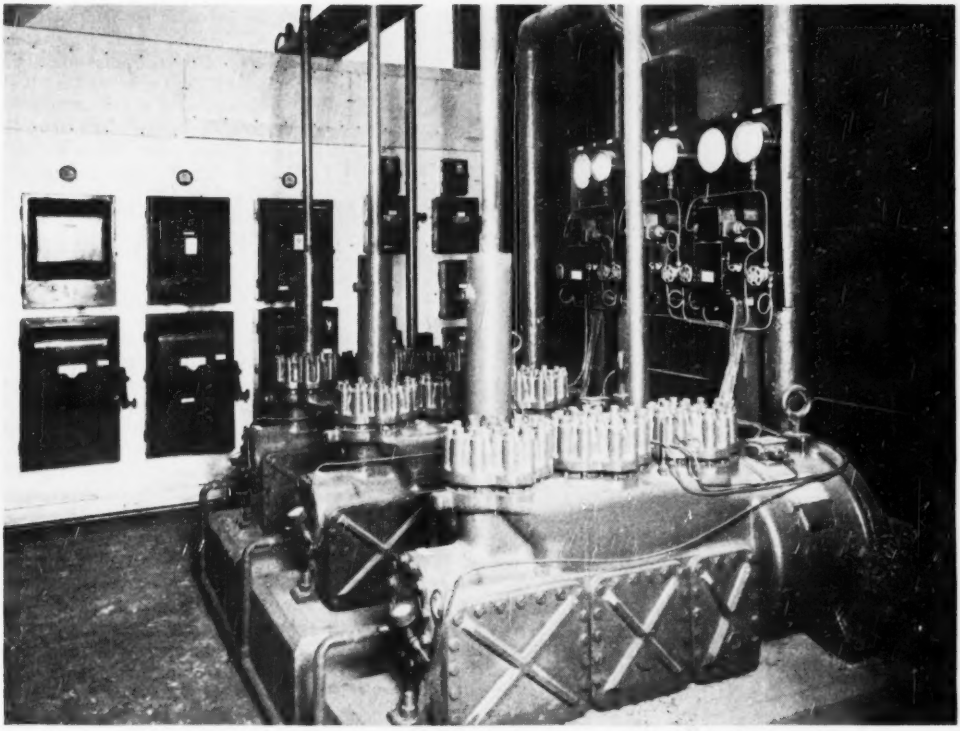
Typical of the group is the station arrangement shown in accompanying illustrations. Provision was made in the initial design for approximately seven 13,200-v supply lines and an equal number of industrial lines, four 13,200-v to 2,400-v transformer banks with nameplate ratings of 7,500 kva, and from 27 to 31 2,400-v distribution circuits.

In the original design the four 7,500-kva transformer banks were intended to supply a firm distribution load of 22,500 kva. They are of the air-blast type and operate with an effective average ambient temperature of 25 C in winter and 30 C in summer. By taking advantage of the margin below 40 C in the ambient temperature, it was possible to apply normal ratings of 9,000 kva and four-hour emergency ratings of 12,000 kva to the transformer banks, thus increasing the firm 2,400-v distribution load capacity of the substations to 36,000 kva. Capacity of the supply lines was increased by adding a second cable in parallel with the existing one.

Dissipation of the additional equipment losses resulting from the increase in capacity presented no problem, except in the case of a basement room where the 2,400-v distribution circuit induction regulators, current limiting reactors, instrument transformers, and auxiliary bus are located. Losses of this equipment are about 90 kw on the basis of the initial design of 22,500-kva load and 160



BASEMENT PLAN of typical urban type substation. Arrangement of refrigerant compressor, cooling units and discharge ducts is shown



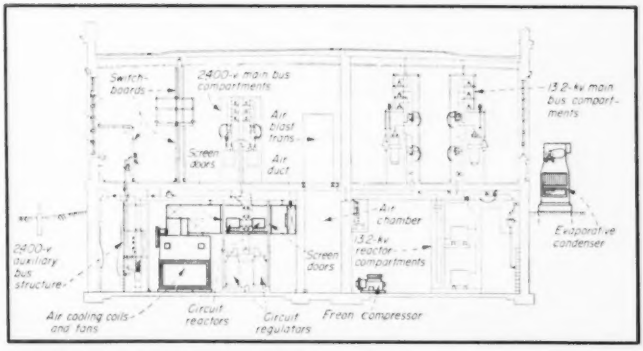
REFRIGERANT COMPRESSORS used in connection with air cooling installation. Control panel is in rear.

kw on the basis of 36,000-kva load. Somewhere between these two load values the ambient temperature in the room will exceed 40 C. The actual load where this occurs will differ among the substations, depending largely on the individual circuit ratings and the distribution of load among the circuits.

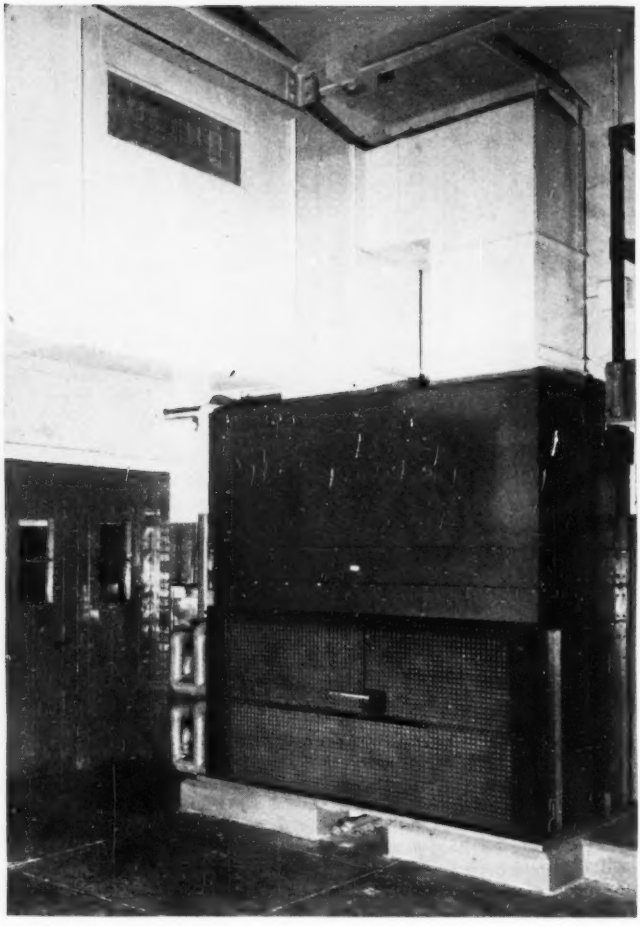
Two Steps

First step in increasing the distribution circuit capacity of a given substation was to install larger equipment on individual circuits. The original design provided for circuits of 150 and 200-amp capacity. Design ratio of the total circuit load to total circuit capacity was 70%. New standard ratings of 200, 300 and 400 amp were applied and load to circuit capacity ratio was increased to 85%. Circuits were rerated to the new values as required by load conditions until the load reached a point where the ambient temperature in the room became a limiting factor.

Second step was to provide means of dissipating heat so that further load increases could be carried and still hold the ambient temperature to a reasonable value. Forced-air ventilation was considered and used to a limited extent. It did not prove practicable for three reasons: (1) It was difficult to provide intake and discharge openings of sufficient size in the basement walls; (2) the high air velocity necessary for the quantity of air required was objectionable to personnel; and (3) noises and transit oil odors were objectionable to adjacent neighbors.



SUBSTATION SECTION showing relative locations of air cooling unit, refrigerant compressors and evaporative condenser with respect to station apparatus



AIR COOLING UNIT showing connections to discharge duct. Fire hazard control thermostat is seen at air intake

The possibility of maintaining a satisfactory ambient temperature in the room by the use of refrigeration equipment was suggested. A study indicated that the scheme would be both practicable and economical because: (1) It would permit operation of equipment at ratings above nameplate by maintaining a controlled ambient temperature below 40 C; (2) no outside air would be used, making the recirculated air clean and of low humidity, thereby reducing cleaning of equipment and minimizing the possibilities of condensation; (3) better working conditions for personnel would result by avoiding the high drafts occasioned by forced air.

Two trial installations were made. One employed a package-type air cooling unit comprising a 25-hp refrigerant compressor, cooling coils with a 5-hp air-circulating fan, and condenser cooled by city water. This unit was located in one end of the room to be cooled. The other installation used a separate compressor and cooling unit and an outdoor evaporation type condenser. In this case the compressor was 50-hp capacity but was run at reduced speed and equipped with a 25-hp motor. The fan for the cooling unit was driven by a 3-hp motor. An air duct was run from the cooling unit down the aisle adjacent to the compartments housing the induction regulators, current limiting reactors, and current transformers. Air was directed toward the equipment which generated the heat.

Although many difficulties were encountered during the first year of operation none were insurmountable. Practicability of the scheme was confirmed and enough information made available to proceed with additional installations without further experimenting.

Conclusions drawn from the experience with the trial installations were these:

1. More compressor capacity was required for both installations. Compressors operated almost continuously and so required more than normal maintenance.

2. Compressor and cooler capacity should be installed in two or more units, to insure adequate cooling while maintenance work is being performed.

3. Air duct system was more effective because the cold air could be discharged where the heat is generated, thereby maintaining a more uniform temperature throughout the room.

4. Cost of city water for condenser cooling was excessive, making an evaporative-type condenser more desirable.

The two installations were modified as a result of this operating experience. For the one with the 50-hp capacity compressor, the 25-hp motor was replaced by a 50-hp motor. Speed was increased to gain full capacity. Later, a second 50-hp compressor was installed to firm up the cooling capacity.

Where a "package" type unit was used, having a 25-hp compressor, changes included removal of the compressor from the "package" unit and installing it together with two additional 25-hp compressors in another location. One of these three compressors is normally in reserve. A second air cooling unit was provided and simultaneously, an evaporative-type condenser was installed outdoors to reduce water consumption.

Nine Installations In Use

Nine cooling installations have been made to date. A tenth has been authorized. Listed in the table are ratings of the major equipment for each installation. Note that either

two 50-hp or three 25-hp compressors are used. Experience has shown that with this capacity available, required temperatures can be maintained without excessive maintenance of compressors. Sufficient reserve is also available to cover all contingencies, *including* one compressor out of service for maintenance.

More recent installations have the air duct openings spaced to agree with compartment widths. This gives even distribution of air directed to the desired location. Because of physical limitations, current transformers are in a hot location above the two current-limiting reactors. The ambient temperature differential between this point and the induction regulators was about 18 C without cooling. It was reduced to about 8 C with cooling and was completely eliminated when an air duct was used.

Fans in the air coolers run continuously to provide air circulation at all times. Compressors are thermostatically controlled. The thermostat is set at 82 F (28 C) from Apr. 1 to Oct. 31, and at 62 F (18 C) from Nov. 1 to Mar. 31. These settings are intended to provide efficient and economical operating conditions, taking into consideration seasonal load variations. Compressors are operated in sequence with one, two, or three units running, depending on the requirements. The sequence can be changed by a selector switch so that the running time of the units can be balanced. A record of running time for each unit is made on a clock-type device. This sequential operation distributes wear on all units and provides for more uniform maintenance.

Total cost of installing cooling equipment in the last substation to be equipped, which was in 1948, was approximately $46,000. Of this amount about 25% went to increase 240-v light and power capacity.

NINE SUBSTATIONS, of which this is typical, use refrigerated air to cool basements

With the air-cooling equipment in service, the distribution circuit capacity of this substation was increased by 3,200 kva without making any changes to circuit equipment, either in the station or in the street. This increase in capacity resulted from the application of above-nameplate ratings to the 200 and 400-amp circuits which had excess capacity in the street cables. Additional circuit capacity will be made available as needed by increasing equipment and conductor sizes until the ultimate distribution load of 36,000 kva for the substation is reached.

Conclusions

It would be difficult if not impossible, to express in dollars per kva the cost of the distribution circuit capacity made possible because of the installation of air cooling equipment. The main objective in installing the equipment was to make available distribution circuit capacity at a lower cost than would be possible from new substations. This objective was not only accomplished, but the economies realized were exceptional. Sufficient circuit capacity was made available, by the lowering of the ambient temperatures alone, to more than justify the cost of the air cooling equipment. The additional capacity obtainable by changing circuit equipment can be provided at comparatively low cost because a considerable portion of the equipment of a circuit need not be changed to increase the capacity.

About 330,000 kwhr of energy is used annually to operate the cooling equipment for each substation. Average yearly maintenance cost per installation is about $500.

Air cooling as described in this article fulfills the requirements of a specific problem. It has proved to be decidedly economical in this case, but it could not be justified for all cases where increased substation capacity is desired. In many instances, increased capacity may be more economically obtained by using forced-air ventilation or relocating some of the heat-producing equipment outdoors when conditions permit. For example, in Philadelphia Electric's suburban and rural areas, where load densities are lower and substations are of smaller capacity, forced-air systems without cooling have been found more economical. New urban substations are now being built where most of the heat producing equipment is installed outdoors, in walled-in courts. A forced-air system is used to cool the air within the building. It is unlikely that the need for air cooling in these substations will ever exist.

Rating of Major Air Cooling Equipment Used In Various Substation Installations

Substation	Design Losses in kw at 36,000 Kva Cap.	Compressors No.	Compressors Rating (hp)	Air Circulating Units No.	Air Circulating Units Size (hp)	Evaporative Condenser Size (hp)
Adams	155	2	50	2	5	7½
Federal	165	3	25	2	10	7½
Oxford	160	3	25	2	5	5
Powelton	155	3	25	1 1	3 2	5
Race	165	3	25	2	5	5
Upper Darby	155	3	25	2	7½	5
Washington	160	3	25	2	5	5
Wissinoming	160	3	25	2	5	5
Wister	145	2	50	1	5	3

FIELD HEADQUARTERS TRUCK serves as coordinating center for supervisors directing service restoration during system emergencies

Emergencies Handled from Office On Wheels

Emergency field forces directed from field headquarters truck equipped with radio-telephone, conventional dial phones, working space and facilities for six persons at once

GEORGE W. KIEFFER
Superintendent's Assistant
Emergency Division
Distribution Operation Department
Consolidated Edison Co of New York, Inc

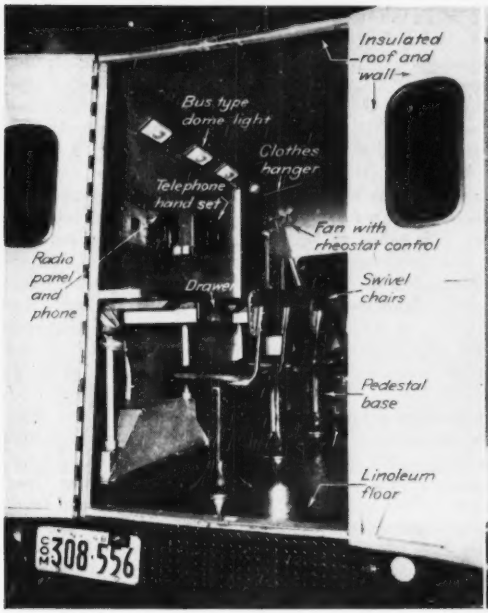
MOST ENGINEERS who have worked in the field during system emergencies have at one time or another offered up fervent prayers for some place—any place—with light, shelter and a phone from which work could be directed with as little loss of time, temper and public convenience as possible.

At such times when needed most, liaison between company departments, city authorities and other utilities is seldom at its best. More often than not communication is through "runners" shuttling between the scene of the emergency and the nearest phone or is maintained in the cramped quarters of a two-way radio car.

To improve these unsatisfactory conditions and so speed service restoration, Consolidated Edison Co of New York, Inc has recently fitted out a special emergency field headquarters truck to serve as a reporting and coordinating center for field forces on major emergency jobs.

The truck has all the facilities for coordinating operations, including a radio-telephone, two conventional dial telephones, heater, desk space, lights and dual power supply system. Working space and facilities are provided for as many as six men at a time. As the illustrations show, these facilities are housed in a one-ton panel truck having package delivery type body.

Standing by at the Service Bureau central office, the headquarters truck is ordered out when the General Foreman on duty feels that the emer-



LOOKING FORWARD through rear doors, desk, chairs, lights, phones are visible. There is working space and facilities for six men

POWER SUPPLY can be supplied externally or by battery. Throw-over switches are in box at rear. Locked cabinet houses radio

gency requires coordination of men and equipment. He sees that the necessary maps, plates, etc, for the area are placed on board and dispatches to the scene the necessary supervisory personnel for manning the truck. It is also his job to make arrangements to have the New York Telephone Co connect the telephone equipment on the truck to the company's channels. In the majority of cases the telephone company's representative has been at the location awaiting arrival of the truck.

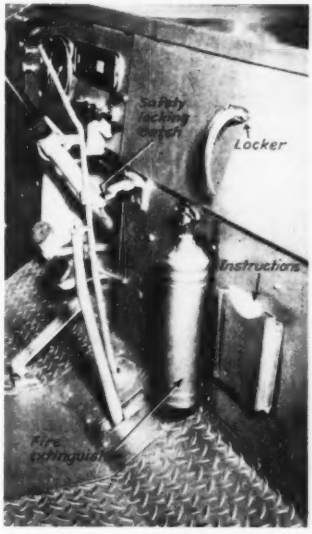
Once on the scene the coordinator on the headquarters truck sets up the plan for restoration of service and from then on all operations for the affected area are handled through the headquarters truck.

Features and Facilities

The package delivery body of the truck is standard. It is heat insulated on top and sides and has been fitted with a number of special features and facilities.

On the outside of the truck there are three receptacles:

1. Connection for 120-v a-c supply is directly above the rear step at right. This is for external supply to the 120-v a-c to 6-v d-c rectifier and the 1,500-w heater.



GEAR SHIFT is locked in neutral when engine is supplying energy for radio and lights

2. Supply for the New York Telephone Co connection, upper rear right side panel, connects the two dial telephones to the telephone company's central office.

3. Receptacle for headquarters flag, right side panel forward. This flag is a notifying marker displayed when the truck is in use.

Three portable reels of cable make the connections to the receptacles mentioned above under items **1** and **2.** Two are for the telephone connections–one for connection to the truck, and the other for an extension line. Both are 150-ft long. The third reel of cable is for the 120-v a-c supply consisting of 50 ft of No. 10 two-conductor cable. The 120-v supply for the truck is taken from the nearest pole, manhole or lamppost. The reels and auxiliary extensions are stored on the floor under the table in the truck.

Aerial for the radio telephone is on the front right hand side of the vehicle. This location was chosen as tests proved this to be the most suitable location for the best reception and transmitting.

A signal light with purple lens on the top of the truck is used for two

purposes. First, to indicate location of headquarters truck when parked and second for a paging light by pressing the button under the work table inside the truck.

Inside the truck in the right rear corner, there is a switch box containing two dpdt switches for controlling the main 6-v supply. With the switch in the "up" position equipment is connected to the truck battery and the truck engine must be kept running to charge the battery. In the "down" position, the equipment is connected to an external a-c supply receptacle through a rectifier. This rectifier has a capacity of 50 amp and is used to charge a battery connected to the 6-v installation on the truck. It is installed in a cabinet under the seat on the right side of the truck.

As a safety precaution, when the truck motor is running to supply energy to the radio and lights, a safety arrangement locks the gear shift in neutral so it cannot be accidentally pushed into speed by persons entering or leaving the truck.

There are two 6-v fans with rheostat control mounted in the two front corners of the truck, facing the two louvers in the rear panels.

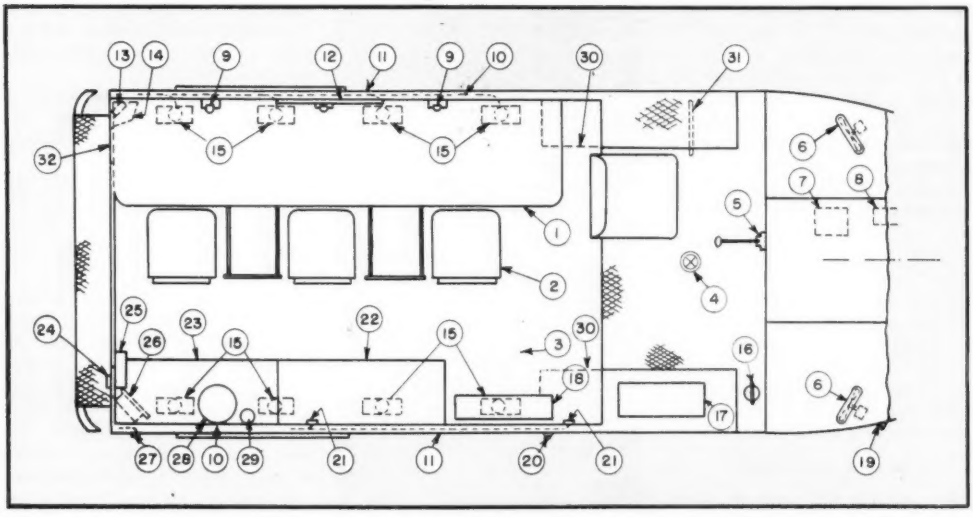
There is a 1,500-w, 120-v heater mounted on the floor adjacent to the rectifier.

A table 2 ft x 8 ft is along the entire length of the left panel. It is covered with linoleum and has two drawers in which the necessary maps, charts, specifications and stationery supplies are kept. The three swivel back chairs are floor-mounted. There are eight bus-type ceiling lights, four on each side; a clock, two-gallon thermos jug, cup and towel dispensers and two duplex, 120-v outlets for electric appliances.

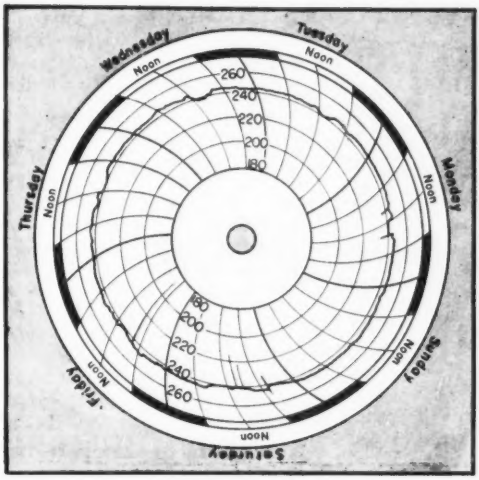
The headquarters truck has proved itself on a number of emergencies since it went into service. Typical emergencies were: underground secondary cable failures, broken water mains and consequent washouts, gas leaks in street mains, manhole fires and similar system disturbances requiring several crews. In some of these cases weather was such that it would have been difficult to use maps and sketches unprotected from the elements. The headquarters truck provides a cubicle which is dry, warm and well lighted. The duration of time the truck has been on location has varied from one and a half hours to as long as forty-five and a half hours.

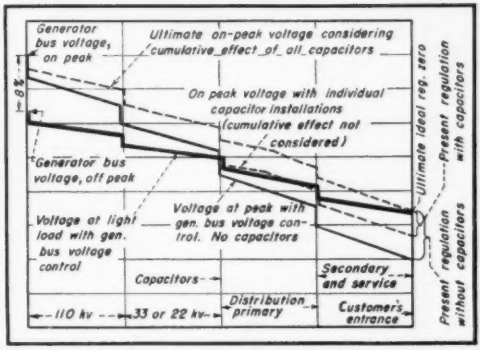
It has been found that the truck provides several advantages, some of which are: (1) Improved coordination because of the centralized location of field operations, (2) an appreciable saving of time due to rapid communications and ability to plan the restoration, (3) minimum interference with the public, (4) greater safety in operations, (5) ability to handle the job with the minimum amount of manpower and (6) elimination of weather hazards by providing mobile office facilities.

Use of a model, which the supervisory force inspected and commented on during design stages, is without doubt one of the principal reasons why the truck has proven so satisfactory on all its assignments. Except for minor changes it would be duplicated essentially as it is to provide more vehicles of this type.



FACILITIES ARE ARRRANGED COMPACTLY in the one-ton package delivery-type truck. 1—Table with linoleum top, monel metal trim and two locked drawers. 2—Swivel type pedestal base chairs. 3—Floor covered with linoleum with metal cove moulding at sides. 4—Pageing light on top of body. 5—Safety locking catch for gear shift lever. 6—2 swivel type 6-v fans with rheostat control. 7—Hot water heater. 8—Leece Neville Rect Alt Current Gen System. 9—Two telephone hand sets. 10—Insulation-sidewalls and roof. 11—All wiring concealed in body panels and in wiring troughs at sides and rear of body. 12—Radio panel including voltmeter, radiophone receiver and trans-m switches and operating indicating jewel lights. Located over table. 13—Clock in monel frame—hand wound. 14—Waste container under table. 15—Four bus type dome lights on each side of body mounted on angle. 16—Fire extinguisher. 17—Floor mat. 18—120-v electric heater. 19—Aerial on side of body. 20—Socket on side of body for field flag. 21—120-v duplex outlets. 22—Cabinet with lock for misc storage and rectifier, leather cushion on top utilized as seat. 23—Locked cabinet for 2 way radio equipt, battery, 120 amp switch. Top covered with linoleum and monel tril utilized as table. 24—Water tight outlet for external elect connection. 25—Paper towel container. 26—Switch box with two-60-amp single pole double throw switches. 27—Two receptacles for telephone connection. 28—2-gal thermos jug. 29—Paper cut dispenser. 30—Tool storage compartments under truck floor accessible from step. 31—Clothing hanger under roof. 32—Set louvres both sides of body with hinged covers inside.




Generator bus voltage, on peak
Ultimate on-peak voltage considering cumulative effect of all capacitors
± 8%
On peak voltage with individual capacitor installations (cumulative effect not considered)
Ultimate ideal reg. zero
Present regulation with capacitors
Generator bus voltage, off peak
Voltage at light load with gen. bus voltage control
Voltage at peak with gen. bus voltage control. No capacitors
Capacitors
Secondary and service
Present regulation without capacitors
110 kv
33 or 22 kv
Distribution primary
Customer's entrance

RELATIVE LEVELS approached by controlled capacitors in conjunction with generator bus voltage regulation (above)

REGULATION with 2,500-kw load at substation 13.4 miles on 33-kv circuit from 110/33-kv substation loaded to 6,000 kw. No regulators. 540 kvar with 3-step control substituted for induction regulators

Bus and Capacitor Control Improves System Performance

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WITH GENERATOR bus voltage control as applied on the Penelec system* the usual types of capacitor control are inadequate to cut the capacitors off at light load. This is so because voltage is usually as high or higher on peak than at light load at most locations on the system.

A new type of control† was therefore developed to operate under these conditions and is being installed on all banked capacitors. Capacitors are normally on during the load period and normally off during the light load period but should the voltage drop to an abnormally low value during the light load period, the capacitors will come on to sustain the required light load voltage. The accompanying circular chart illustrates the good results that can be obtained from the combination. It is evident that such good regulation greatly increases the load-carrying ability of the system.

Objections to this scheme have been raised from time to time but none have proven serious when given a sufficient amount of consideration:

1. "Voltage variation will not exactly correspond to the change in load and the resulting regulation for any given substation or customer." The same objection could be raised to any regulated circuit serving more than one customer. The only customers or substations whose regulation would not be improved by the voltage control at the generator bus would be those who have their peak during the seven or eight hour period when voltage is below the mean level. Of these only ones close to generating stations would be materially affected.

2. "Control is not necessary on the entire amount of capacity installed because the system can stand a certain amount of fixed capacity." Control which will take the capacitors off on light load is desirable on all installations for two reasons: (A) Under varying conditions of generating station loading, one station or another will find it difficult to meet its low voltage schedule at light load without operating at such a high power factor that it may become unstable. This is the determining factor in setting the voltage schedule for several stations. (B) Reactive component at light load is beneficial (see gradient diagram) in holding light load voltage down, thus aiding in improving regulation. Fixed static capacity can therefore have no beneficial effect on regulation but will have to be duplicated by controlled capacity.

3. "The current element in the control is unnecessary in many instances." This would be true if the capacitors were installed at points on the system where the light load voltage was definitely higher than "on peak" voltage and where the capacitors would not bring this differential to a critically low value so that the capacitor would be apt to be on the line at light load. Also, the current element helps to give the voltage control a definite "cut off" point which makes the setting of the control less critical. Therefore the current element is essential where adequate capacity is to be installed.

* See Electrical World, Nov. 27, 1943, page 52.
† See Electrical World, Dec. 6, 1947, page 89.

MICROWAVE ANTENNA installation on system of the Pennsylvania Electric Co, Johnstown. Two parabolic antennas, one for transmitting and one for receiving, are mounted on the antenna tower of the company's mobile FM communication system

MICROWAVES New Power System Tool

Space radio, operating in the micro-wave frequency ranges, offers an effective means of meeting unprecedented demand for additional communication facilities on large interconnected power systems

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Central Station Engineer
Westinghouse Electric Corp
East Pittsburgh

THE FUTURE of microwaves for power-system communication, control and relaying is bright. Frequency bands are available and equipment developed specifically for power system use has begun to appear on the market. The necessity for additional power system communication facilities, already urgent, is becoming more acute day-by-day as systems grow, and there is greater need for more efficient operation to offset rising costs.

Microwaves will relieve the greatly overtaxed power line carrier frequency spectrum of the necessity of providing relatively short haul communication channels, permitting the use of those frequencies for long-haul circuits where microwave channels cannot be established economically. Thus it appears certain that microwaves will soon become as indispensibly a part of the overall communication facilities of our power systems as power line carrier is.

There is no standardized boundry line between conventional radio frequencies and those that may be termed micro-wave frequencies, but in general the term "microwaves" may be applied to all waves of less than 100 cm in length or higher than 300 megacycles in frequency. In this region tubes of conventional form, even the miniature types, reach the limits of their capabilities and cease to function as amplifiers, oscillators, etc. This is also the region where ordinary lumped-constant tuned circuits give way to tunable lines and cavities.

The development of radar and associated techniques just prior to and during the war made the use of microwave frequencies practical for a variety of communication purposes. The Federal Communications Commission, recognizing the possibilities of the microwave frequencies for these purposes, and in order to relieve the extreme congestion of the lower frequencies, has allocated a number of different frequency bands in the microwave region for industrial point-to-point communication service. Electric power systems are specifically included in the group of services.

The microwave frequency bands available for point-to-point use by power systems and other industrial services are shown in Fig 2. These frequencies are not available to government power agencies, whose assignments are made in the government bands. These are also shown. In some cases these government bands are adjacent to the industrial bands, and in one case there is an overlapping assignment. There is no point-to-point government band near the industrial band 952 to 960 Mc.

At present these frequencies are reserved for industrial use on an experimental basis, pending the availability of commercial equipment. There is every indication that the

frequency assignments will be made permanent as soon as equipment is generally available and commercial use is made of them.

Characteristics of Microwaves

In many of their characteristics, microwaves behave more like light than like lower-frequency waves. Microwaves are not reflected by the ionosphere as are frequencies below about 50 Mc. They do not follow the curvature of the earth as do signals in the broadcast and low-frequency radio bands. They tend to travel in straight lines and are subject, like light, to diffraction, refraction, and to reflection from plane surfaces. Objects in the path of microwave signals cast shadows which become more and more sharply defined as the frequency is increased. At frequencies above about 6,000 Mc, attenuation of signals by rain and snow become an important factor. A microwave path must, therefore, be an optical or line-of-sight path with some clearance of obstacles if a reliable circuit is to be obtained.

Under some weather conditions there is sufficient variation in atmospheric temperature and water-vapor content with altitude to produce a gradient in the dielectric constant of the lower atmosphere which tends to refract microwave signals slightly toward the earth. This effect produces an apparent increase in the radius of the earth to about 4/3 of its actual radius. For power system applications which require the utmost in reliability, however, a true optical line-of-sight should be provided. This refraction effect can then be considered as a safety factor.

Both natural and man-made static are almost entirely absent in the microwave region, and that which does exist is subject to the same propagation effects as actual signals. Static is therefore not a serious problem, and the minimum useful signal strength for service of a given quality is usually determined by noise generated in the receiving equipment itself.

The signal received over a line-of-sight path will depend mainly upon the relative phase and magnitudes of the direct signal and that received by reflection from the ground intermediate between the transmitting and receiving points. The main cause of

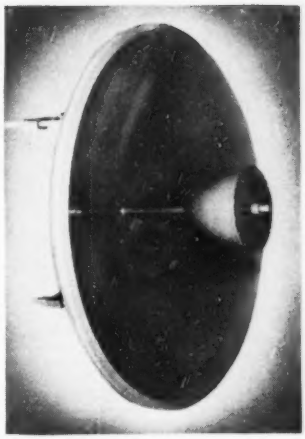

FIG 1—PARABOLIC ANTENNA used with microwave installations. The dipole radiator is covered by a plastic dome for weather protection. Larger dishes may be perforated or slotted to reduce windage

fading over such a path is variation in the characteristics of the atmosphere which affects the apparent path length of either or both of these components and hence the relative phase between them. Fading becomes more rapid and more severe as the frequency is increased, even though the amount of signal reflected by the ground is less at higher frequencies. This has been explained on the basis that rapid and severe variations often occur in the make-up of small regions of the atmosphere, regions which appear relatively large, in terms of wavelength, to the higher-frequency microwaves. Fading of the lower-frequency microwaves depends upon variations over larger regions, which in effect appear to average out the rapid and violent fluctuations which may be obtained over more limited areas.

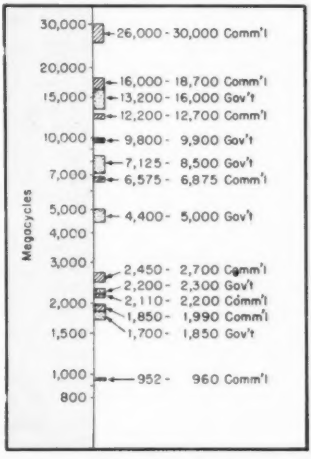

FIG 2—ALLOCATIONS in the microwave frequency spectrum for point-to-point commercial and government use

The enormous gain in signal strength that can be obtained by using parabolic reflectors for transmission and reception of microwaves makes it possible to provide a reliable circuit with a very small amount of transmitted power. For example, many of the microwave channels in use in television relaying systems use transmitted powers of the order of only a few milliwatts.

Multiplexing

One of the most attractive possibilities of microwaves derives from the relatively enormous amount of space, in terms of bandwith, that is available in each of the allocated bands. Even the 952-960 Mc band, the narrowest of the available assignments, is 8 Mc wide. This makes it possible to use multiplexing systems, which permit a single microwave carrier to be modulated simultaneously by several independent voice channels or a combination of voice channels and control or telemetering channels. The result is economy in channel space and equipment which permits a greater number of useful func-

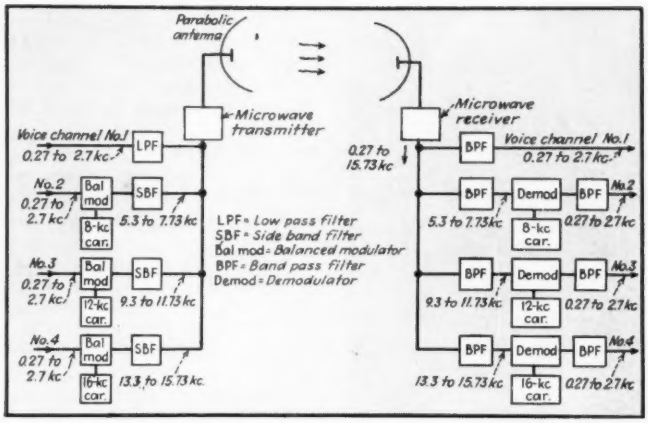

FIG 3—SENDING AND RECEIVING ends of a typical frequency division multiplexing system. Although only four multiplexed channels are shown, frequency-division multiplexing appears economically applicable for as many as seven channels per microwave carrier

tions in a given bandwith at a substantial saving per function.

Multiplexing systems take two distinct forms. One of these is frequency division multiplexing, an example of which is shown in Fig 3, in which the microwave carrier is modulated (usually frequency modulated) by voice-frequency audio signals along with one or more low-frequency carriers, each of the latter being modulated independently by voice-frequency signals. The low-frequency carriers (sometimes called sub-carriers) may be amplitude or frequency modulated, or they may be suppressed after being used to generate corresponding single sideband signals for modulating the microwave carrier. This is the most economical multiplexing system for less than approximately eight voice-frequency channels per microwave frequency.

For eight or more channels, time-division multiplexing appears to be the more economical system. In this system, the wave form of each voice-frequency signal is sampled or examined individually thousands of times a second. The amplitude of the signal at the time of sampling is used to control some characteristic of a pulse such as amplitude or phase with respect to a reference value. With a pulse-repetition rate which permits each signal to be sampled at a frequency several times the highest frequency contained in that signal, the original wave can be reconstructed from the received pulses with negligible loss of fidelity.

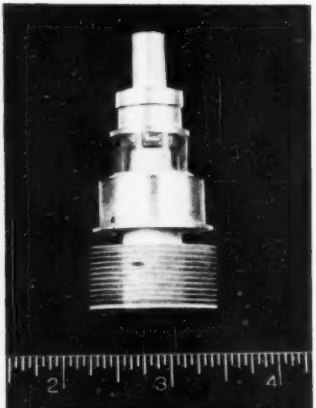

FIG 4—LIGHTHOUSE TRIODE for microwave use. This particular triode is rated for use up to 2,500 Mc

Advantages of Microwaves

Microwaves as a communication medium for power systems offer a number of distinct advantages as compared with other facilities in common use. Paramount among these advantages is channel reliability, for a microwave channel is not dependent upon the continuity of transmission line conductors or pilot wires for its operation. For some of the microwave bands, tubes are available with life comparable to that of tubes used in lower-frequency equipment, and from the standpoint of continuity of service, microwave equipment should be at least comparable to carrier.

An other advantage which contributes materially to the reliability of microwaves is freedom from interference. This derives mainly from the line-of-sight characteristic, the directivity of the antennas employed, and the enormous amount of spectrum space available.

Being independent of power lines or other conductors, microwave channels can be established between points which are not suited to the establishment of carrier channels. For example, an ideal application of microwaves is the establishment of a channel from a dispatching office in the center of a city, where transmission lines are not available, to an outlying substation where carrier telemetering and communication channels normally terminate. A single microwave channel with multiplexing facilities can provide a link over which several sets of voice signals and dozens of telemetering and control indications can be transmitted.

The use of pilot wires has been the practice for the relaying of cable circuits because of the high attenuation which power cables exhibit at carrier frequencies. Pilot wires are themselves subject to certain troubles such as induction during faults and mechanical damage. Microwaves have none of these disadvantages. They are particularly applicable to the relaying of cable circuits because the length of most such circuits places the terminals within easily obtainable line-of-sight of each other.

Microwave equipment will be relatively easy to maintain as compared with telephone lines or power-line carrier. Maintenance on microwave equipment can be performed without the necessity of taking any part of the power system out of service, as is required for maintaining some parts of a power-line carrier system.

The line-of-sight characteristic, although it is in many respects an advantage, will also in some case obviously constitute a disadvantage for microwave applications. Repeater stations are perfectly feasible from a technical standpoint, but their use will materially increase the cost of

providing microwave communication.

The provision of a continuous power supply will be a problem in microwave installations where the normal a-c supply is not sufficiently reliable. Power-line carrier has been developed to the point where continuous operation directly from station batteries is possible, but the presently available microwave tubes require higher voltages than station batteries normally supply. It may be necessary to resort to the use of normal a-c supply with automatic emergency transfer to an m-g set or other apparatus operating from the station battery, a practice which has been followed in some important power-line carrier installations.

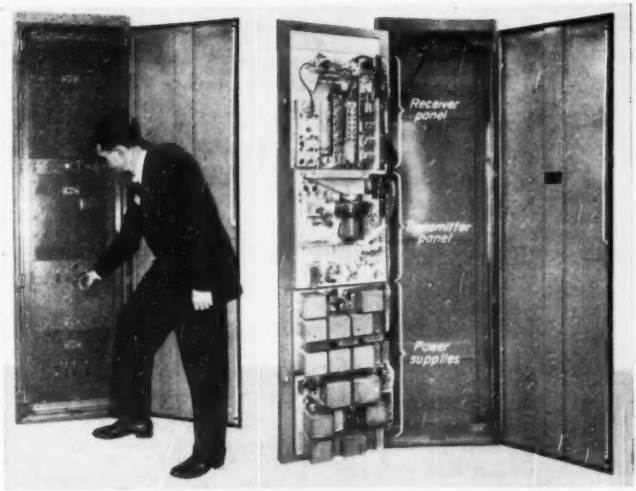

FIG 5—TRANSMITTER-RECEIVER for 952-960 Mc band, designed especially for power system use. Crystal control is used for high stability in both transmitter and receiver. Final stages of transmitter use "lighthouse" triodes at reduced power for reliability and long life

Merits of Available Bands

The microwave bands that will be used initially by power systems will probably be the lower-frequency bands, 952–960 Mc, 1850–1990 Mc, 2110–2200 Mc, 2450–2700 Mc and possibly 6575–6875 Mc. This is explained in part in the propagation characteristics of these frequencies as compared with the higher frequencies. Other reasons are given below:

952–960 Mc. Fading is least severe in this band, but antennas of a given power gain are larger than for higher bands. Several watts of power, more than adequate for good signal-to-noise ratio over any practical line-of-sight distance with antennas of reasonable size, can be generated in transmitters of more or less conventional design using crystal oscillators and frequency multiplying stages. The only departure from conventional low-frequency practice that is required is the use of tunable cavities or tuned lines instead of lumped-constant resonant circuits in the final multiplying stages. Disc-seal or "lighthouse" tubes, Fig 4, which are similar in their operation to conventional tubes, can be used in the final stages, and the use of klystrons and magnetrons, with attendant replacement problems, is therefore unnecessary. Solid-dielectric, flexible coaxial lines can be used between the transmitter and the antenna with moderate losses for lengths up to several hundred feet, making it possible to install all equipment except the antenna indoors at ground level. This band is narrower than the higher-frequency bands, but its 8-Mc width can accommodate a relatively enormous number of channels in a given area, particularly if full advantage is taken of line-of-sight characteristics, antenna directivity, and frequency spacing. This band appears to be the most promising one for immediate use where the number of multiplexed channels required per circuit is seven or less.

1850–1990, 2110–2200 and 2450–2700 Mc. The relatively greater width of these bands suits them particularly well to systems using pulse multiplexing, in which a great number of channels per microwave frequency may be used. Many of the advantages of 952–960 Mc are retained, although to a somewhat lesser degree. Tube efficiencies are lower, but disc-seal triodes have been developed for several watts output at frequencies up to 2500 Mc and may be used over most of these three bands. Crystal-controlled transmitters do not appear feasible, because of the large number of multiplying stages required, and frequency stability becomes an important design and operating factor. Automatic frequency control may be required in receivers, which offsets materially the gains in simplicity made by eliminating crystal control of the transmitters. Only short lengths (50 ft or so) of flexible coaxial cable can be used, and the rigid coaxial cable or waveguide required for longer distances increases installation expense. An alternative is to mount the transmitter proper close to the antenna, but this is usually undesirable from a maintenance standpoint. Smaller antennas can be used for a given gain in these bands as compared with 952–960 Mc, but large antennas should probably be retained to provide adequate margin for the more severe fading which can be expected in these bands.

In general, these bands appear best suited for "de-luxe" trunk-line installations where large numbers of individual voice-frequency channels are required between two points.

6575–6875 Mc. In this band the use of klystrons or magnetrons is practically required since conventional-type tubes, even those of special construction such as the disc-seal or lighthouse type, are not readily applicable. Enormous power gains can be obtained with parabolas of relatively small diameter, as compared with those for lower-frequency bands, but to offset this the amount of r-f power that can be obtained economically is limited to fractions of a watt. Waveguide must be used between the transmitter-receiver and the antenna unless the distance is extremely short. Attenuation due to rain, sleet, and snow become noticeable in this band.

Fifteen-Ampere Branch Circuits Are Obsolete

Doubling and redoubling of household loads necessitates recognition in wiring and protection. Comprehensive and intensive study supports recommendation of upping to larger wire and 20-amp protection

AS THE RESULT of two years of effort a comprehensive study of the requirements of residential branch circuits has been completed. This study covers branch circuits in dwelling occupancies including single and multi-family dwellings and individual apartments. The scope of this work is outlined briefly as follows:

1. A survey to determine the prevalence of fires from electrical causes.

2. A study of the present and future load requirements of residential branch circuits and the effect of starting characteristics of modern electrical appliances.

3. A review, re-study and tests of the current carrying capacities of branch circuit conductors.

4. A study to determine the optimum time-current characteristics of branch circuit protective devices.

5. A study of the physical design of existing and proposed protective devices to determine the possibilities of coordination and interchangeability of future designs.

6. A survey to determine the operating experience with plug fuses.

IN NOVEMBER 1946 the Edison Electric Institute and the Association of Edison Illuminating Companies organized a committee which was designated as the EEI-AEIC Joint Committee on Branch Circuit Protection and whose purpose was: "... to conduct a fundamental engineering study of the overcurrent protection problem as it relates to branch circuits, including a reexamination of the basic objectives of such protection and the best methods of obtaining them, with due regard to the effects of the trend of heavier capacity systems to supply increasing loads."

Basic Conclusions

The following summary is based upon surveys, studies, and tests which are a part of the complete report:

1. Over the past two decades branch circuits have been carrying greatly increased loads and larger inrush currents. This trend has accelerated in recent years. During this 20-year period, general purpose branch circuits have been restricted to a 15-amp rating. An increase in rating of the general purpose branch circuit to 20 amp is now needed and is practicable.

2. From the transient and continuous operating characteristics of various types of loads are derived the time-current characteristics of branch circuit protective devices that are required to (a) carry the continuous load, (b) permit the flow of starting or inrush currents, and (c) operate to protect branch circuit conductors and flexible cords under short circuit and overload conditions.

3. The required time-delay characteristics are obtainable with protective devices now available. With a feasible modification in the time-current characteristic of present devices, a 20-amp protective device will provide protection in the short circuit current range equal to that of existing 15-amp protective devices.

4. An increase in the minimum branch circuit rating from 15 amp to 20 amp and the general utilization of time-delay protective fuses will

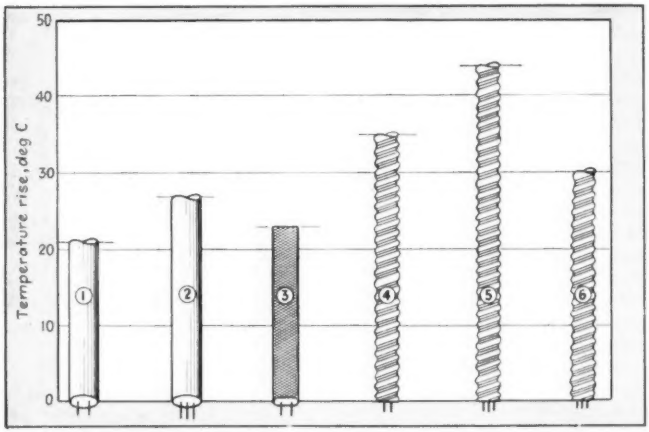

FIG 1—TEMPERATURE RISE of No. 14 conductors carrying 15 amp in insulated wall panels: (1) and (2) Two and three Type R in ½-in. black enameled and galvanized conduits, respectively; (3) and (4) Two conductor non-metallic sheathed and armored cable; (5) and (6) Three conductor armored with current in three and two conductors, respectively

greatly reduce unnecessary fuse blowing from transient conditions and, consequently, will tend to minimize bridging and overfusing.

5. A survey of fires and improper fusing practices indicates that a small percentage of the total fires are of electrical origin and, though overfusing and bridging of circuit protective devices are appreciable, these practices do not appear as major factors in causing fires.

6. A survey of plug fuse experience shows that the mechanical design of the Type S fuse has caused considerable trouble and resulting confusion principally because this fuse cannot be used in the Edison base fuse holder without an adapter.

7. A study of other suggested designs of tamper resisting fuses indicates that several have been developed (at least one commercially), any one of which apparently provides complete interchangeability, that is—usable with or without adapter in Edison base fuse holders and interchangeability of fuses and adapters of different manufacture. To coordinate with the increased capacity of the general purpose branch circuit, such fuses would logically be in two classes—0 to 20 amp and 21 to 30 amp.

8. Protection for manually started motors of less than one horsepower merits further study by the proper group.

Fire Causes

A survey of the electric light and power industry and local government fire records indicates that the number of fires attributed to electrical origin is a small percentage of the total fires.

Replies from 61 companies serving some 6,600,000 customers (nearly one-fifth of U. S. total) provide the following figures:

	Total Number	Percent of Customers	Percent of Building Fires
Customers	6,587,000	.....	.....
Building Fires	110,378	1.7	.....
Alleged Electrical Fire	8,414	0.1	7.6

Data from a few groups reporting inspection of all alleged electrical fires list motors (chiefly under one horsepower) as a major cause. The survey shows appreciable overfusing and bridging of overcurrent protective devices but does not show that overfusing and bridging are major factors in causing electrical fires, although any reduction of this potential hazard is desirable.

Reports on improper fusing of branch circuits from 21 companies covering 214,000 fuse calls give the number of cases of overfusing as 16.2% and the number of cases of bridged fuses as 2.7% of the fuse calls made.

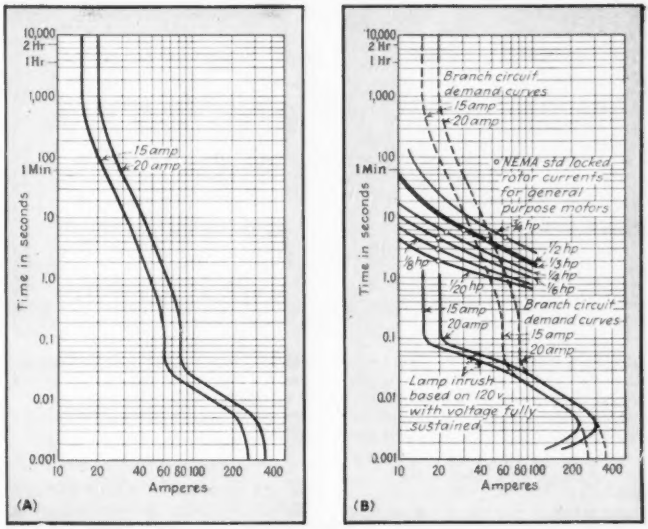

FIG 2—PREFERRED DEMAND CURVES for 15 and 20-amp circuits: (A) The lower short-time characteristics recognize lamp inrush as seen from (B) which also shows that the preferred demand curves permit running over-current protective devices (one make) to operate properly on standard locked-rotor currents of fractional horsepower motors (except ¾ hp)

Load Requirements

Some 25 years ago—when one or two No. 14 wire branch circuits were generally accepted as adequate—the average annual usage per residence was less than 400 kwhr. In 1947 it was over 1400, an increase of about 250%. In the past twelve years it has doubled. Averages of 5,000 kwhr—more than ten times that of a quarter century ago—must be kept constantly in mind when planning for a future in which electricity will play an ever-increasing role in the living habits of our population.

Inrush currents at present constitute a major consideration in the design of the circuit protective device. Motor-driven appliances are growing constantly as the greater usage of pumps, fans, and other major appliances continues. The inrush current of a circuit fully loaded with incandescent lamps also requires consideration. There appears to be little doubt that the increase in starting requirements of motor driven appliances has been a major cause for the overfusing and bridging of branch circuits and that the recognition of this factor in the circuit protecting device is essential.

The 15-amp minimum circuit rating in use for many years should be increased. From strictly a load standpoint, perhaps the minimum size might be doubled, resulting in a 30-amp circuit—30 amp being the maximum size plug fuse now accepted. For the reasons stated in the report, it is concluded that the minimum rating of the general purpose branch circuit should be 20 amp.

Development of Demand Curves

In establishing the branch circuit demand curves so that the circuit may perform its function of supplying, in a satisfactory manner, continuous loads within its rating, including the imposed inrush currents, three major and reasonable requirements must be

Adaptation of "Report on Branch Circuit Over-current Protection" about to be released and obtainable from Edison Electric Institute

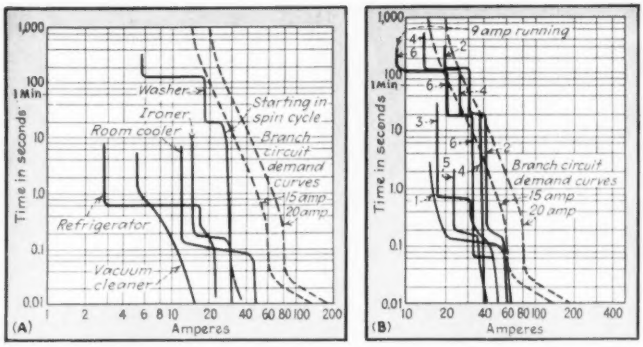

FIG 3—BRANCH CIRCUIT DEMAND CURVES (A) contemplate starting of typical appliances individually on 60 ft of No. 12 wire; (B) similar adequacy is afforded by the 20-amp curve for simultaneous starting of combinations of two such appliances; (1) Room cooler and sweeper, (2) washer and ironer, (3) refrigerator and ironer, (4) washer and 1,000-w iron, (5) ironer and 1,000-w iron, (6) washer and refrigerator

fulfilled. These are as follows:

(a) It must provide for a continuous load equal to its rating.

(b) It must provide for the inrush current of incandescent lamp load with cold filaments.

(c) It must provide for the starting of appliance motors when this duty is added to other load, if any, on the circuit.

The middle portion of the demand curves as prescribed in (c) is largely determined by the starting characteristics of motor driven appliances.

The 15-amp circuit demand curve encompasses all the characteristics shown for the individual appliances. But if the source voltage were maintained during the starting of the washing machine and ironer together, the 20-amp curve would not encompass the time-current values imposed, whereas, if the voltage drop is great enough the 20-amp curve is adequate. This shows an important effect of voltage drop in the circuit during starting. The reverse of this effect is also often the case, in that voltage drop may so prolong the starting period as to exceed the limits of practical time-current values for the circuit.

Certain appliances with particularly severe starting characteristics cannot be used on 15-amp multi-outlet circuits with other loads without exceeding the limits chosen and the permissible load in addition to some individual appliances on the 20-amp circuit is severely limited. For instance, a certain washing machine and ironer, even though requiring a total of only 20-amps, would require time values on simultaneous starting such as to result in an impractical situation. Also, certain combinations may start satisfactorily on 15-amp circuits but will exceed the continuous rating of the circuit.

Reasonable combinations of appliances that the 15-amp circuit demand curve does not include tend to set the limits for the 20-amp circuit demand curve. The combinations are common for laundry and kitchen appliances and were chosen as being reasonably typical. However, these time-current values will include combinations such as room coolers and appropriate appliances used in other locations as well.

At both the long time and the short time ends of the two circuit demand curves, the curve for the 20-amp circuit for a given time value results in a corresponding current value equal to 133⅓% of the current value for 15-amp circuit. It seems logical, therefore, that at all values of time the current values of the two curves should bear this same relationship.

Tests made under the direction of the Joint Committee by Underwriters' Laboratories, Inc included two and three-conductor assemblies of armored cable with conductor sizes of No. 14, 12 and 10. Armored cable was used for most tests because preliminary investigations showed that it had a higher temperature rise than non-metallic sheath cable or conductors installed in conduit. In general, the tests showed that these sizes of conductors under normal installation conditions reach a 30 C rise at current values close to or slightly in excess of present Code ratings for current carrying capacity.

Tests on two-conductor No. 14 armored cable under normal installation conditions showed that the temperature limitation is not exceeded with a 20-amp continuous load. This indicates that two-conductor No. 14 taps for individual outlets may be safely made to a No. 12 branch circuit having a 20-amp protective device.

The tests also included a study of temperature rise with greater-than-normal loads for short periods of time on 20-amp branch circuit conductors. The tests showed clearly that there was no overheating of the branch circuit conductors under the usual conditions of higher than rated transient currents when a properly designed 20-amp protective device having a suitable time-current characteristic was used.

Flexible cords may also be protected in the case of short-circuit by a suitably designed 20-amp overcurrent device to substantially the same extent as is now afforded by the standard 15-amp protective devices. The load on a flexible cord is usually limited by the load of the appliance to which it is attached, but, if currents higher than normal but less than the short circuit current range (due to high impedance faults within the appliance) should persist, the 20-amp protective device will operate to open the circuit before the temperature of a No. 18 cord reaches a dangerous level.

Branch circuit protective devices rated 15-amp or greater do not protect the clock cords or tinsel cords as adequately as the No. 18 cords. However, a comparable degree of protection is afforded in the short circuit current range. Thermoplastic insulated cords will generate smoke in less time (at high values of current) than rubber insulated cords.

Electrical Characteristics of Protective Devices

To be suitable, branch circuit protective devices must (1) carry the continuous load to be served, (2) permit the higher inrush currents of

such loads as incandescent lighting and motors, and (3) protect the conductor from overload and short circuit. With the increased use of motorized appliances on branch circuits, it is apparent that suitable time-delay protective devices must be made generally available and the public educated as to their use. Development of protective devices with time delay characteristics has now reached a point that the universal use of the time delay feature appears to be practical.

There is little question but that the use of motor driven appliances with high inrush currents tends to cause unnecessary operation of non time-lag branch circuit overcurrent protective devices. Increasing the minimum circuit rating from 15 to 20 amp will reduce some of the unnecessary fuse blowings and further improvement will be effected by the use of the proper time delay characteristic in the protective device. Such a characteristic provides time delay in the range of motor starting appliances but retains the fast blowing time in the short circuit range, thereby making it possible for a 20-amp fuse or other protective device to give the same degree of protection in the short circuit range as is now provided by the conventional 15-amp zinc fuse. The application of these two features—*increased capacity* and *time delay*—will greatly reduce the number of cases of unnecessary fuse blowing and will thus eliminate a large part of the *cause* of overfusing and bridging of protective devices.

Mechanical Design of Protective Devices

In general, fuse type protective devices, which must be replaced by the public, require interchangeability. For instance, fuses of the same class must fit all fuse holders in the same class, irrespective of manufacturer. Since the Edison base fuse has been used satisfactorily for many years, it offers the best basis for development of any new feature that might be required. The Type S fuse does not offer complete interchangeability, since it cannot be used in the millions of existing fuse holders without first installing an adapter peculiar to that fuse design. It has proved to be far from satisfactory in some areas where it has been used.

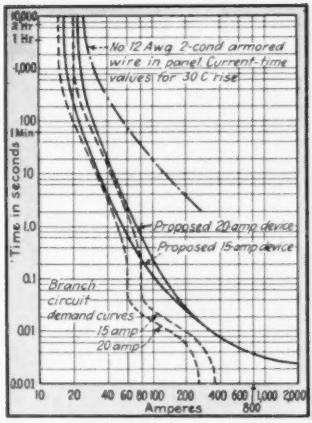

FIG 4—PROPOSED protective devices have characteristics appropriate for the preferred branch circuit demand curves substantiated by the tests

Tamper resisting fuse designs have been developed (at least one type offered commercially) any one of which apparently provides complete interchangeability, meaning—usable with or without adapter in Edison base fuse holders and also interchangeability of fuses and adapters made by the various manufacturers. Any such design of fuse, fuse holder, or an adapter for Edison base fuse holders in two classes—0 to 20 amp and 21 to 30 amp—would coordinate with the minimum 20-amp general purpose branch circuit and the 30-amp branch or feeder circuit.

The "tamper-resisting" feature is effective only to the extent that it makes somewhat more difficult (1) the replacement of a smaller fuse with a larger one, or (2) the bridging of the fuse by a coin or some other simple means. It does not make the fuse tamper-proof. The words "tamper-resisting" and "interchangeability" refer to mechanical features of fuses. They do not necessarily denote the inclusion of any particular electrical characteristics, time-current or otherwise.

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H. K. Sels, Public Service Co of New Jersey, Newark, N. J.

Representing Association of Edison Illuminating Companies
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How To Apply Secondary Capacitors

New low-cost secondary capacitors offer benefits not attainable with primary capacitors. Application principles laid down by the author show how to get maximum economic benefit from this new tool

H. E. CAMPBELL
Power Transmission & Distribution Div
Central Station Engineering Div
General Electric Co
Schenectady

IT HAS long been a generally accepted fact that primary capacitors offer the lowest cost source of kilovars for a distribution system. This was true until recently because the differential in price per kvar of primary and secondary capacitors was heavily in favor of primary units.

This year, however, has seen the introduction of a low-price 3-kvar, 240-v capacitor for secondary service that has changed the economic picture.

Now, although primary capacitors remain lower in price per kva than secondary capacitors, they are *not always* the least expensive source of kilovars. Because they are installed closer to a load requiring kilovars, secondary capacitors offer benefits not possible with primary units.

A kilovar of capacitors on the low-voltage side of a transformer is equivalent to from 1.02 to 1.04 kilovars of primary capacitors because it reduces current through secondary conductors and distribution transformers. This not only cuts I^2X losses but reduces voltage drop or releases load carrying capacity.

Capacitor Costs

Until a comparison is made between the capitalized value of these benefits and the added cost of securing them through the installation of secondary capacitors, the economics of a given application should not be pre-judged in favor of higher voltage units.

Installed cost of 2,400/4,160-v primary capacitors will probably run $9/kvar when installed in small quantities such as 45 kvar. Price of the 3-kvar, 240-v capacitor is about $10/kvar. Installed cost of secondary capacitors is estimated to be $13/kvar. Thus the difference in the installed cost of the secondary vs primary capacitor is about $4/kvar.

This difference in installed cost, whatever it is for any particular system, is all that has to be liquidated when using secondary capacitors and this must be less than the values of additional benefits if it is to be a profitable investment. Of course this assumes that primary capacitors could be justified in small quantities on the primary feeder.

These additional benefits of locating capacitors on the secondary can be evaluated as follows: (1) Reduction in voltage drop between the first and the last customer on the feeder when capacitors are located only on the secondaries furthest out on the feeder; and (2) released distribution transformer capacity.

Voltage Improvement

The voltage improvement obtainable in a distribution transformer and secondary with a 3-kvar secondary capacitor is shown in Fig 1.

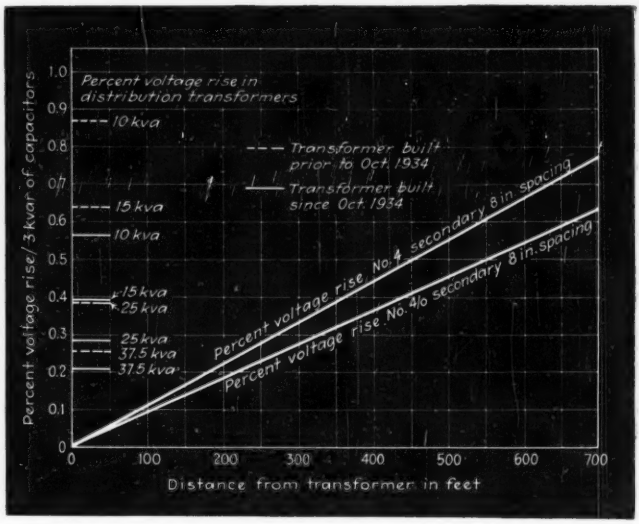


FIG 1—VOLTAGE RISE in distribution transformer and in secondary conductors resulting with 3-kvar capacitor connected to secondary. Read percent voltage rise for several ratings of distribution transformers directly at left. Voltage rise for No. 4 or 4/0 conductor is read from curves. Percent voltage increase is doubled for 6 kvar of capacity.

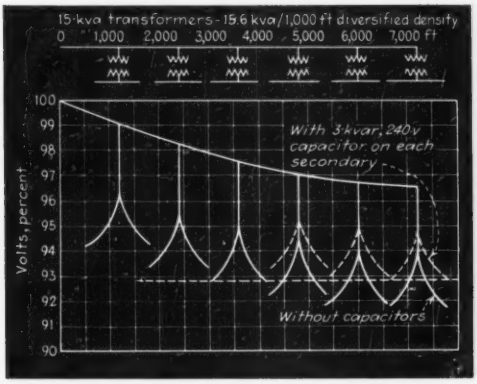


FIG 2—VOLTAGE PROFILE of lateral distribution feeder shows voltage improvement between first and last customer before and after installing 3 kvar of capacitors on each of last three transformers

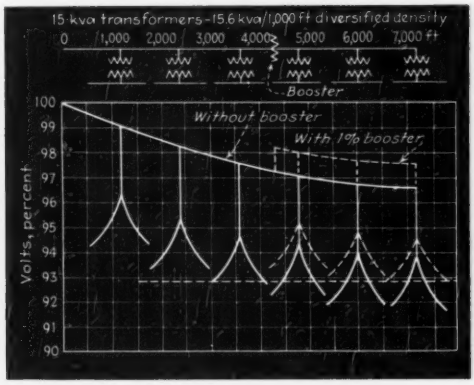


FIG 3—VOLTAGE PROFILE of lateral distribution feeder shows voltage improvement between first and last customer before and after installing booster in primary feeder circuit

This voltage improvement is over and above that which might be obtained by the same amount of kvar placed on the primary side of a distribution transformer.

Gain to Last Customer

From Fig 1 we can determine the voltage improvement obtained by connecting one 3-kvar secondary capacitor 300 ft on each side of a 15-kva transformer. If the transformer is modern, the curve shows a 0.78% voltage improvement in the transformer with 6 kva of capacitors on the transformer. Also, there is about 0.3% voltage improvement in the secondary with 3 kvar of capacitors connected 300 ft out on the secondary. This is a total voltage improvement to the last customer of about 1%. If the transformer is an older design, the voltage improvement would be 1.28% in the transformer, making an improvement to the last customer of about 1.5%.

How the voltage difference between first and last customer can be improved by using secondary capacitors on the last distribution transformers is shown in Fig 2. The figure shows about 1% improvement in voltage. Such a voltage improvement between first and last customer of a distribution feeder is worth real money to many distribution engineers. One utility engineer has shown in a paper that a 1% voltage improvement between first and last customer is worth $6,000 to him in terms of system investment. To realize a 1% improvement with secondary capacitors, they would have to be installed on all the distribution transformers farthest out on the feeder, not just on one lateral run as shown by Fig 2. A typical distribution feeder would probably have 14 laterals similar to Fig 2. Therefore, to obtain 1% voltage improvement with secondary capacitors, 6 kvar of secondary capacitors would have to be installed on each of three transformers of each 14 laterals which amounts to approximately 252 kvar of capacitors. The additional cost for this amount of secondary capacitors over the cost of primary capacitors is approximately $1,000 ($252 \times \$4 = \$1{,}008$). This is a 6 to 1 cost ratio in favor of the secondary capacitors when compared with system investment.

Boosters Could Be Used

A booster could be used to reduce the voltage drop between the first and last customer on a feeder at a lower cost than rebuilding a distribution system. When using a booster in an urban feeder it is important that the permanent boost be not so great as to cause an over-voltage at times of light load. Probably from 1 to 1.5% permanent voltage improvement is all that can be tolerated in most feeders between first and last customer.

How a booster can be used to improve voltage is shown in Fig 3. Installed on a lateral as shown, a booster would cost approximately $156. It would require 18 kvar of secondary capacitors to give this same voltage improvement. This

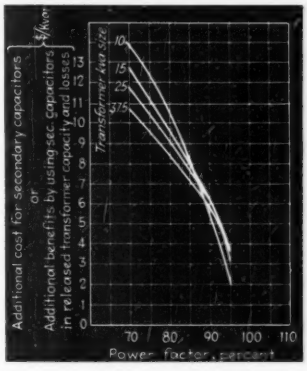


FIG 4—IT IS ECONOMICAL to use two 3-kvar capacitors on the secondary each way from transformer when load power factor at time of peak is about 91%. Assumptions: (1) Distribution transformer loaded 125%, (2) No. 2 secondary, (3) Energy loss cost 7 mills/kwhr, (4) Demand loss cost $200/kw, (5) Losses capitalized at 12.5%, (6) Load factor 40%, (7) Loss factor 24%

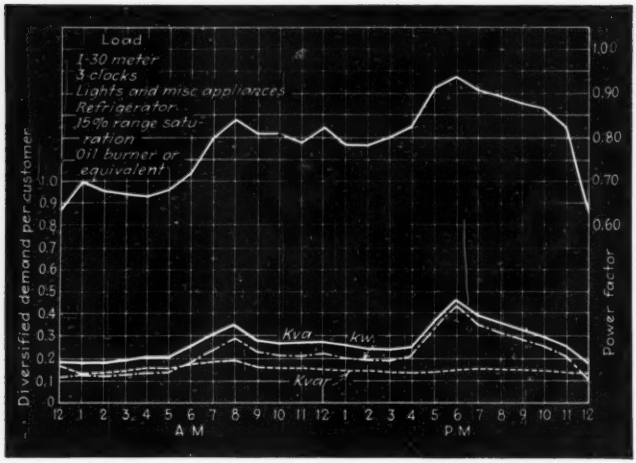


FIG 5—DAILY DIVERSIFIED DEMAND of average residential customer

would amount to $72 (18 x $4 = $72) above the cost of primary capacitors. This is a ratio of 2 to 1 in favor of the secondary capacitors.

Thus, secondary capacitors used near the end of feeders can be a lower cost way of getting voltage improvement as compared with other methods.

Transformer Capacity

The incremental cost of distribution transformers is small. Thus the value of the capacity of a distribution transformer released by a secondary capacitor will not be as large as the additional cost of an installed secondary capacitor. Thus, releasing the capacity in a single distribution transformer with capacitors is not favorable to the secondary capacitor.

However, if a group of distribution transformers along a primary feeder is considered and a comparison is made between putting in secondary capacitors and adding more distribution transformers, the increase in losses caused by the additional transformers can be taken into account. Such an analysis has been made for different sizes of distribution transformers and various load power factors and the results are shown in Fig 4. The assumptions for calculating losses used in this analysis are shown in Fig 4. These may be high for some utilities. Lower values would make it less attractive for the capacitor. Here, as in previous examples, the additional installed costs of the secondary capacitor are compared with the additional benefits of released distribution transformer capacity.

It will be seen from Fig 4 that it is economical to use two 3-kvar capacitors on the secondary of distribution transformers when the load power factor at time of peak load is less than approximately 91% and the distribution transformers are loaded to approximately 125%.

Application

It is believed that the improvement in voltage between first and last customer on a feeder is where the secondary capacitor will find its greatest use, because other ways of improving voltage are expensive.

The application of secondary capacitors with respect to quantity and location is easy. It is a case of matching load reactive with capacitors. The daily load curve of a residential customer looks like that shown in Fig 5. This is the diversified demand per customer when he is one of a group, ie, this is what the secondary and transformer see as a load for each customer. Observe in this figure that the kilovar component of the load is relatively constant all the time. This is because only the automatic kilovar loads, those which operate 24 hours, have been shown. Loads such as washers, vacuum cleaners, mixers, etc have not been included. Hence, secondary capacitors in quantities to match the kilovars shown in Fig 5 should be used in order to obtain the economies shown previously.

Fig 5 shows the diversified kilovar requirement per residential customer to be about 0.2 kvar all the time. Therefore, secondary capacitors could be applied in accordance with the number of customers, allowing 0.2 kvar per customer or any other value which may be known for a particular location. Thus a distribution transformer with 25 to 30 customers can justify 6 kvars (30 x .2 = 6 kvar) of capacitors—one 3-kvar unit on each side of the transformer.

The 3-kvar secondary capacitor has been arranged for direct pole mounting and should be placed on the secondary feeder, like any 240-v load, out from the transformer, usually about halfway between the transformer and the end of the secondary. This will be a central location with respect to the kilovar requirements of most feeders and thus will give maximum benefits.

Conclusions

Secondary capacitors should be applied in accordance with the number of customers on a distribution transformer. Since the number of kilovars used by residential customers is relatively constant, they can be matched with permanently-connected secondary capacitors. The amount of capacitors needed can be determined by allowing 0.2 kvar per customer.

If voltage improvement between first and last customer on a feeder is desired, then the capacitors should be used only on the distribution transformers near the end of the feeder. If released distribution transformer capacity and reduced number of transformers is the prime objective, then secondary capacitors should be used on every secondary in the area where such conditions are desired.

Single Wood Brace Saves 75¢ Per Arm

H. N. DILLER
and
J. A. MOORE
Engineering Department
Central Illinois Public Service Co
Springfield, Ill.

THE SAVING of over 75¢ per single arm can be made by using only one wood brace per arm on wood brace distribution construction, and over 21¢ per arm on steel brace distribution construction without sacrificing reliability. This substantial saving is being realized by the company after adequate testing of available wood braces by making slight modifications to fit the condition.

This problem was approached with the thought that a wood brace has the characteristic of being strong in both compression and tension. It was found that single wood braces have more than adequate strength to replace the two braces conventionally used.

Bolts Increase Strength

Tests were made which proved that by the addition of a ½-in. split bolt at both ends of the conventional 1 x 2½ x 30-in. fir brace the strength of the member was increased by approximately 50%.

This provided a single brace which would have a safety factor of 3½ to 1 on a structure where other component parts normally would have a safety factor of 2. To be more explicit, if we consider a 225-lb man on the end of an 8-ft arm, we would have in the single brace a safety factor of 4. If we have three No. 1/0 copper conductors on an 8-ft arm and a 300-ft span, a safety factor of 3½ will be obtained under heavy loading conditions.

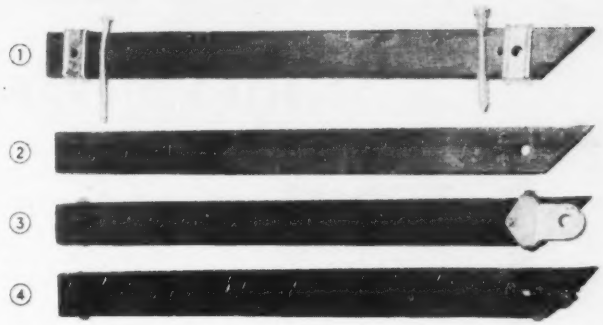
In cases where heavy equipment such as transformers, capacitors and similar equipment are to be supported on double crossarms, two braces are used on the crossarm next to the equipment and none on the second arm.

Since double-deadend arms usually have only one-half the vertical load per arm of single-line arms, it seems logical to install only one brace on each of the double arms. This requires but one lag screw on each side of the pole and eliminates possible splitting of small poles when two lags are driven in the same side.

Data in the table was obtained by applying load vertically to the arm 29½ in. from the through bolt. The brace was, in each case, in tension as it was found that in compression the single brace developed strength considerably in excess of that in tension.

In comparison with accompanying test data, a few other tests were made with two 1 x 2½ in. braces with clips on a single arm and it was found that the average failure was at 1,556 lb.

With reference to the use of lag screws, there were only two cases throughout the tests where the lag screws pulled out of the pole. Both cases were with a 5½-in. diam, creosoted, yellow pine pole. Where the lag was driven beside a knot, failure occurred at 1,300 lb. The second case failed at 2,400 lb in a special test. There was no failure of the lag with cedar poles.



BRACES were tested as shown: 1 With clips; 2 dowel; 3 metal eye; and 4 with split bolts

Strength Test For Single Wood Crossarm Brace

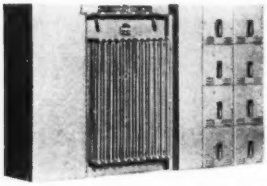
Description	Failure
1 x 2½ in. with clips	Average 880 lb
1 x 2½ in. with metal dowel	Average 1250 lb
13/16 x 2½ in. with metal dowel	Average 1080 lb
1 x 2½ in. with split bolts	Average 1337 lb
1 4 x 28 in. steel braces (2)	Failed at 1600 lb

Results of Test

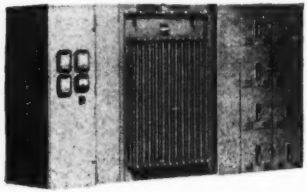
The braces were attached to the arm with ¾-in. machine bolts and to the pole with ½ x 5-in. fetter drive lags. With all the braces under test it was found that failure frequency was about equal at the lag and at the arm bolt. This indicated that the attachment holes are properly located at both ends of the brace. It also shows that a stronger pole attachment method, such as the use of through bolts in place of lags, would add very little strength. The brace with the metal eye at the lower end is designed to be used as one of a pair of braces and although it has adequate strength, it is not well suited for single brace application.

New load-center unit

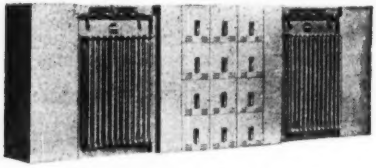
Shorter shipments, when you order 'Selected Standards'



Typical 500 kva G-E *selected standard* load-center unit substation (standard arrangement). Unit consists of primary interrupter switch, liquid-filled transforming section, and low-voltage feeder switching section with the new Type AK-1 drawout air circuit breakers. Reverse arrangement is also available at same price.



Typical 500 kva G-E *selected standard* load-center unit substation with liquid-filled transforming section, metal-clad air power circuit breaker for incoming line-protection, and low-voltage feeder switching section with the new Type AK-1 drawout air circuit breakers.



G-E *selected standard* double-ended load-center unit substation rated 1500 kva with primary interrupter switches, liquid-filled transforming sections, and low-voltage feeder switching section with G-E Type AK-1 drawout air circuit breakers arranged for secondary selective service.

Based on surveyed demands of industry and proposed NEMA specifications, *selected standard* ratings have been introduced by General Electric to bring you these efficient new load centers on shorter shipment. The most popular *selected standard* ratings are . . .

Low voltage	480△ or Y, 208Y/120 volts
High voltage	2.4, 4.16, 4.8, 12, 13.2, 13.8 kv, delta
Kva ratings	300, 500, 750, 1000, 1500, 2000

Certain other *selected standard* load centers are available. Contact your G-E sales representative for further information.

SHORTER SHIPMENTS By ordering *selected standards*, you get 20 per cent shorter shipments on Pyranol and dry-type load centers. Deliveries are in line with average plant construction schedules and it is suggested that load centers be ordered when construction begins.

HIGH IMPULSE LEVELS Pyranol unit substations with their inherently high impulse levels are particularly suitable for locations that are subject to switching surges and lightning.

ECONOMICAL, too, is a G-E load-center power distribution system . . . no heavy, costly low-voltage feeders, no "piecemeal" purchases, no divided responsibility.

SAVE TIME, also, because G-E *selected standard* load centers eliminate weeks spent over drawing boards detailing individual items; you'll save time because G-E factory-assembled unit substations are quickly and easily installed—in the center of the load area—with lower material and labor costs then required for "piecemeal" assemblies.

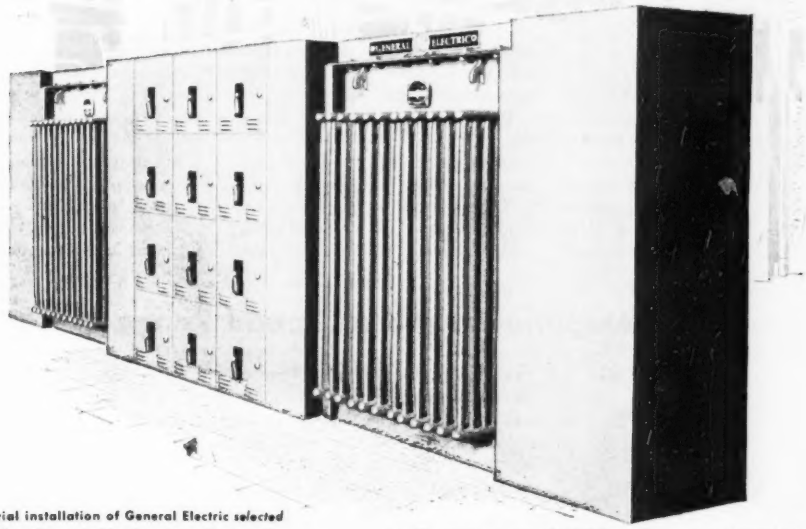
Ask your G-E sales representative *today* about how *selected standard* load centers can save time and money in *your* plant. Also, write for Bulletins GEA-3592 and GEA-3758. *Apparatus Department, General Electric Co., Schenectady 5, New York.*

substations give you...

Improved appearance

at no extra cost!

Note the smooth, integrated appearance of these new General Electric Pyranol* unit substations . . . no more gawky, "old-type" stovepipe connections between transformer and switchgear . . . now you can get the effortless flow of line and power that characterizes quality equipment for locations where appearance is a requisite. All these features at the same price as previous units.



Industrial installation of General Electric selected standard double-ended load-center unit substation rated 1500 kva, 4160 volts, 208Y/120 volts. Unit has oil cutout in incoming line sections, Pyranol-filled transformers, and the new AK-1 drawout air circuit breakers.

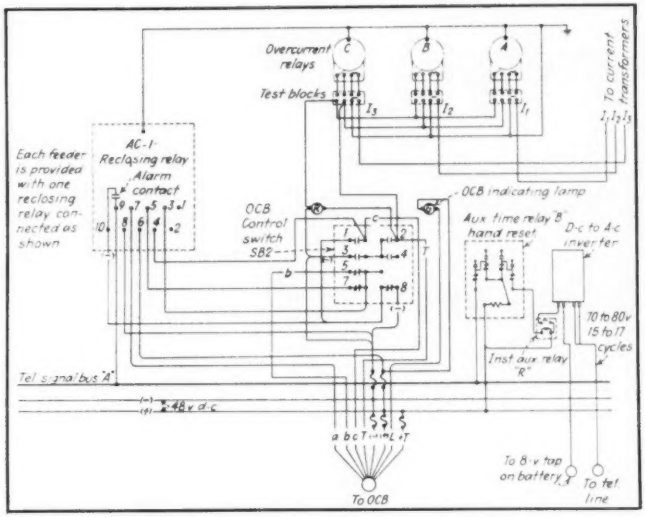
*Reg. U.S. Pat. Off.

★ *Be sure to see the "More Power to America" full-color sound slidefilm "Modern Industrial Power Distribution." Ask your G-E sales representative to arrange a showing for your organization.*

GENERAL ELECTRIC

221-60

Phone-Ringing Inverter Sends Lockout Alarm


Overcurrent relays
Test blocks
To current transformers
Each feeder is provided with one reclosing relay connected as shown
AC-1 Reclosing relay
Alarm contact
OCB Control switch SB2
OCB indicating lamp
Aux time relay "B" hand reset
D-c to A-c inverter
70 to 80 v 15 to 17 cycles
Inst aux relay "R"
Tel signal bus "A"
48 v d-c
To 8-v tap on battery
To tel line
To OCB

CONTROL SCHEME includes reclosing relays for automatic switching and telephone inverter for remote notification of relay lockout position. Signal is sent over abandoned telephone line. Any number of feeder reclosing relays can be connected to signal bus "A"

JOHN I. HURSH
Auburn, Indiana

WHEN a manually operated substation is made automatic much has been gained in high speed restoration of service and operating economy. But in the usual unattended automatic station no means is provided whereby the lockout position of oil circuit breakers can be made immediately known. Sometimes abandoned communication lines can be used for signaling purposes, thereby enhancing the automatization with very little cash outlay. With this idea in mind the author devised a lockout relay remote signal system which tests have shown to be entirely feasible.

The substation at which tests were made operates on a 48-v local battery with automatic charger. The automatic control is accomplished by use of AC-1 reclosing relays with the timing motor operating on 48 v from the station control battery. The relays were set to operate at 15 c for the first fault, 45 c for the second fault, 85 c for third fault, and then lockout if the fault persisted.

Inverter Cuts Cost

The expense of such a system can be kept at a minimum by use of a standard telephone inverter. This device converts low-voltage d-c to a-c power at about 17 c and 80 v for standard telephone ringing service. The inverter is connected into the control circuit as shown in the diagram. If any of the reclosing relays run to the lockout position, they energize the common bus "A" to the hand-reset time relay "B". The latter puts the inverter into operation through an auxiliary relay "R" supplying about 80 v at 17 c to the telephone line. An 8-v tap on the battery was used for the inverter.

Battery Drain Eliminated

The relay "B" was set to give one long ring at the dispatcher's office and then open its own coil circuit as well as the inverter coil circuit, thus eliminating any extra battery drain. Such a signal scheme has proven satisfactory in tests and should pay for itself many times in revenues which might be lost due to outages.

Magnetic Amplifier Increases Speed Range of Motor

J. E. PRIEST
Motor Engineer
Westinghouse Electric Corp
Buffalo, N. Y.

THE COMBINATION of a magnetic amplifier and a metallic rectifier can provide 40 to 1 range of motor speed control with good regulation.

Adjustable speed motors using only the metallic rectifier as a source of d-c power are limited to about 4 to 1 speed range at constant horsepower. The magnetic amplifier extends the range by varying the a-c voltage applied to the rectifier so the d-c output voltage remains constant at any preset value, up to full load. A rectified signal from the armature voltage, or a combination of armature voltage and current, or some signal from a speed indicating device is fed into a magnetic amplifier. A change in the number of watts in the controlling signal changes the wattage output of the magnetic amplifier.

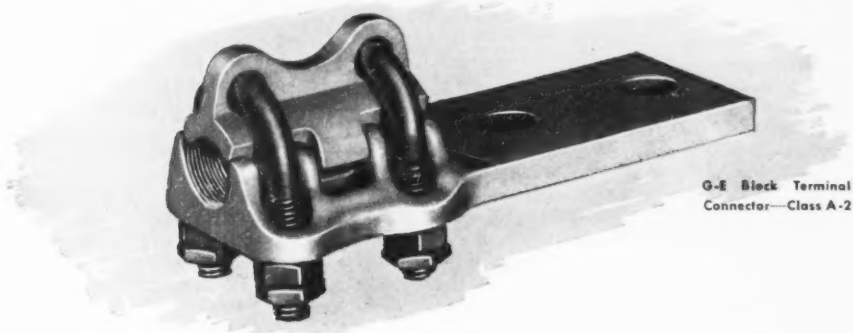
Factors Affecting Amplification

Power amplification of the magnetic amplifier depends on three factors: (1) Type of iron used in the various saturable reactors; (2) type of circuit used; and, (3) the correct load resistance in comparison to the reactor impedance. One magnetic amplifier used for automatic battery charging handles approximately 600 va. This is controlled by a current of 3 ma flowing in a 300-ohm coil; thus the 0.0027 w impressed on the control field produces an amplifiation of 222,000 to 1. About 2 million to 1 amplification has been obtained from two stages.

For good speed regulation it is necessary to have a rising voltage characteristic. The amount of voltage rise depends on the size and char-

From a paper presented at the 1949 Westinghouse Machine Tool Forum, Buffalo, N. Y.

This General Electric power connector can simplify your inventory by 63% to 83%



G-E Block Terminal Connector—Class A-2

Five General Electric power connectors of the type shown above will handle *all* the 22 conductor sizes listed in the table*. Compare this feature with other brands that usually *require a different connector for each conductor size.* You'll immediately realize how much G-E connectors can cut your stock costs by reducing the number of connectors required.

Here are other ways you can SAVE by using G-E connectors.

SAVE TIME—No more stock room safaris hunting for odd-size connectors. When you stock General Electric connectors, you stock fewer connectors. Also, you save time in ordering—you don't have to search through bulky catalogs looking for connectors that are seldom used and are a nuisance to order, besides taking up valuable stock space. G-E connectors are easy to order for the simple reason that you don't have to order so many varieties.

SAVE SPACE—Less stock room space required when you use G-E connectors because fewer connectors are needed to take care of the same range of conductor sizes that you're using now.

SAVE MONEY—When you use G-E connectors you reduce stock storage costs, and you save valuable time in ordering.

CHECK THESE ADDITIONAL FEATURES OF GENERAL ELECTRIC CONNECTORS

SILVER CONTACT SURFACES are a *standard* feature on *all* G-E connectors for use with copper conductors—at no extra cost. This eliminates oxidation problems, assures lower contact losses and longer life.

SERRATED CONTACT SURFACES give extremely high pull-out strength and a permanent, high-conductivity joint that will resist vibration and give positive pressure on the cable at all times.

NON-CORRODIBLE HARDWARE is of high-strength bronze alloy that gives tight and trouble-free service. G-E connectors will not twist, distort, or season crack.

INTERLOCKING SIDES confine the strands of the cable within the conductor enclosure, thus obtaining full advantage of the cable's current-carrying capacity.

Place an order today with your G-E sales representative and start realizing the many benefits to be gained by using this new line of General Electric connectors. Also, write for a copy of bulletin GEC-400 that contains 38 pages of valuable information on these new connectors, and see for yourself how easy they are to order. Write to *Apparatus Department, Section D856-51, General Electric Company, Schenectady 5, New York.*

*General Electric connectors come in a wide range of sizes and types—straight, tee, block, angle, parallel, expansion, ground, and many others. See bulletin GEC-400 for the complete line.

Conductor size	General Electric Catalog No.	Connector Mfg. A	Connector Mfg. B	Connector Mfg. C	Connector Mfg. D
1/0	6151174-9 One G-E connector replaces 6, stock is reduced 83⅓%	√	√	\	√
2/0		\	√	\	√
3/0		√	√	\	√
4/0		√	\	\	\
250		√	\	\	\
300	↓	\	\	\	\
350	↑	\	\	\	\
400		√	None	\	None
500	6151174-59	√	\	\	√
600		None	None	\	√
½ IPS	↓	√	None	\	\
700	↑	None	None	\	None
750		None	None	\	√
800	6151174-88	None	None	\	\
1000		None	None	\	\
3/4 IPS	↓	√	\	\	√
1250	6151174-118 One G-E connector replaces 3, stock is reduced 66⅔%	None	None	\	√
1500		None	None	\	\
1 IPS		None	None	\	√
1750	↑	None	None	\	\
2000	61151174-148	None	None	\	\
1¼ IPS	↓	None	None	None	√
Only 5 G-E connectors for ALL 22 conductor sizes		11 connectors for 11 cond. sizes. No connectors available for 11 conductor sizes	9 connectors for 9 cond. sizes. No connectors available for 11 conductor sizes	21 different connectors for 21 cond. sizes	20 different connectors for 20 cond. sizes

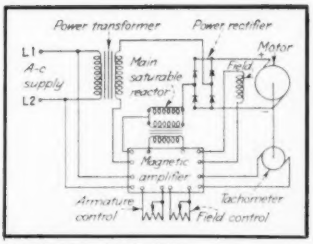
\ Indicates a different connector.

GENERAL ELECTRIC

856-81

acteristics of the driving motor. For example, with a ½-hp motor, the armature voltage may have to rise as much as 50 v to maintain constant speed. A circuit to produce such a rising characteristic must include some reference to both the armature voltage and armature current. Such a circuit could produce good speed regulation, at least at one particular speed setting. Because of slight variations in the amount of rises necessary at different speeds, it is possible to get flat speed regulation at one point, slightly rising at another point, and falling at still another point.

If accurate speed regulation is necessary, a speed measuring device is added to the motor and its output fed into the magnetic amplifier. Actually, this type of circuit would be the easiest to build and operate, since voltage from the speed measuring device serves as a reference.



MAGNETIC AMPLIFIER controls a-c voltage applied to the metallic rectifier

Although it is possible to build these different types of circuits, some factors require additional investigation. A major item is the time constant of the circuit. With a single-stage amplifier and a given amplification, the time constant is high. This may not be serious so far as the overall drive is concerned. If it is too high, some method must be employed to speed up the circuit by some forcing action or through the use of reactors having time constants of lower value.

New Magnetic Materials

New forms of magnetic materials will increase the field of application of magnetic amplifiers. These will effect size, weight, and probably cost reductions. New core material should also bring about lower time constants.

Rehabilitation of Protector Tubes Proves Practical—Economical

E. W. HATZ
Transmission Engineer
Wisconsin Electric Power Co

INCREASED short circuit currents on a 132-kv line with protector tubes have resulted in need for rehabilitating these tubes to meet the new requirements on them.

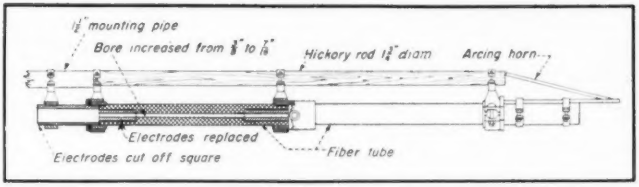
The table compares tube operation before and after the increase in short circuit current.

Bending Force Damages Tubes

Studies and laboratory tests indicated that the performance could be materially improved by a change in the vents, and an increase in the internal diameter. Each unit was built of two sections of fiber tubes with vents at both the line and grounded ends and at the middle. In the tests in which the tubes were damaged, the break consistently occurred in a manner which indicated that damaging stresses were not a result of internal pressure but were due to the action of a bending force.

Vents Are Redesigned

This action developed because the ends of the vents had been cut at an angle of 45 deg, which caused the gas pressure to exert a bending force on the fiber. The remedy was to cut the ends of the tubes off square so that the resulting action from the gases passing through the vent would not subject the fiber tube to the bending force.



BORES of protector tubes were increased from 3/8" to 7/16" and ends were cut square as shown. Increased capacity allows tubes to handle higher short circuit currents satisfactorily

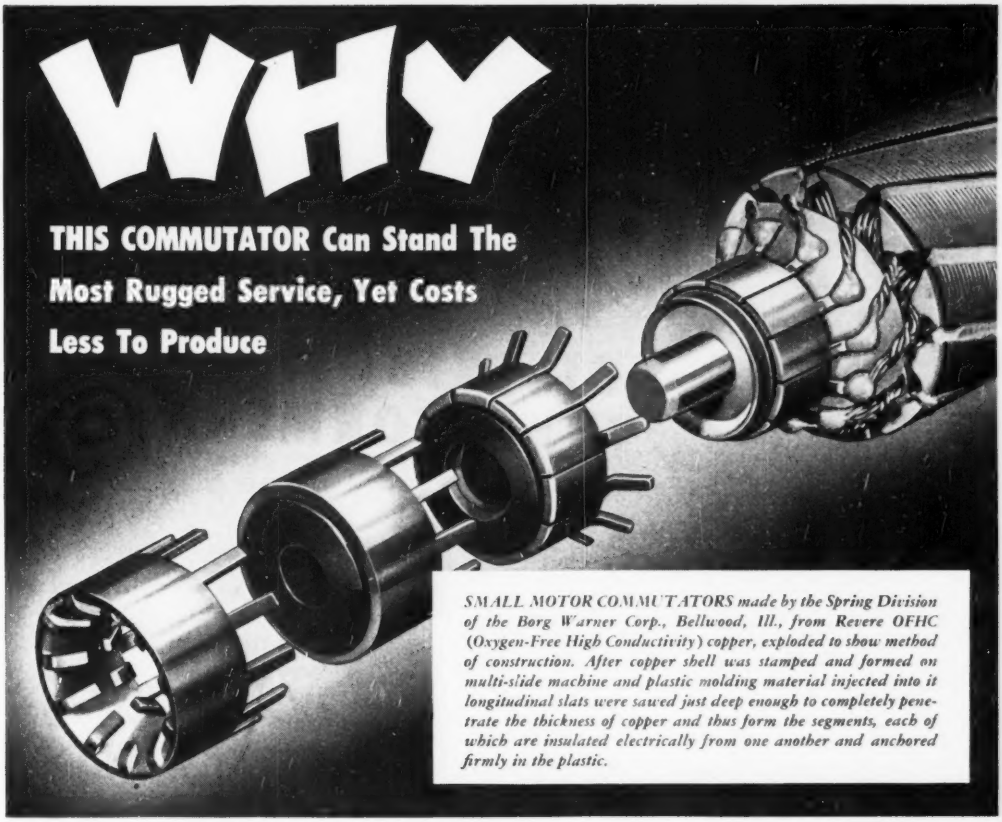
Bores of the tubes were increased from ⅜ in. to 7/16 in. which is comparable to tubes of more recent manufacture, rated at 5,000 amp. This operation requires heating the assemblies to 80 C in order to permit unscrewing the fiber tubes from the metal parts. The reboring operation is not difficult, but precautions must be taken to allow for the warp found in most tubes which have been exposed to the ravaging effects of the weather.

Inspection of the tubes removed for rebuilding shows that the deterioration of the inside of the tube is very slow and the exterior if protected by an application of suitable enamel or paint will have a long life. Rebuilding of transmission line protector tubes is therefore a practical and economical method of obtaining improved protection against interruptions which are initiated by lightning.

Item	8 years 1936-1943	4 years 1944-1947
Number of operations without injury to tube	112	32
Tube damaged but fault interrupted	1	1
Tube damaged and OCB opened	1	2
OCB openings in percent of total tube operations	0.88	6.1
Number of Port Washington generators in operation	1	2
Average fault current when OCB opened	3,000 amp (rms)	3,680 amp (rms)

WHY

THIS COMMUTATOR Can Stand The Most Rugged Service, Yet Costs Less To Produce



SMALL MOTOR COMMUTATORS made by the Spring Division of the Borg Warner Corp., Bellwood, Ill., from Revere OFHC (Oxygen-Free High Conductivity) copper, exploded to show method of construction. After copper shell was stamped and formed on multi-slide machine and plastic molding material injected into it longitudinal slats were sawed just deep enough to completely penetrate the thickness of copper and thus form the segments, each of which are insulated electrically from one another and anchored firmly in the plastic.

IT was quite a complex problem the Spring Division of Borg Warner Corp. dropped into the lap of Revere's Technical Advisory Service. They were getting set to manufacture commutators for small motors and they wanted to select the best material for the job.

Here were the specifications: The material had to be the hardest possible yet still able to take the extremely severe forming operation which was to be done in a multi-slide machine. High hardness was necessary in order to combine maximum wear resistance with the ability to withstand the extreme centrifugal force developed in small motors operating at high speeds. In addition, in the molding operation, which is done after the copper shells have been formed, it was necessary to hold the diameter of the shell to within .001" in order to prevent the plastic from flowing between the mold and the outer surfaces of the commutator. An equal tolerance was also imposed upon the height of the solid cylindrical portion for the same reason. Also of great importance was the need for the cylinder wall being almost absolutely flat.

Because of long experience with somewhat similar problems Revere recommended trial of OFHC (Oxygen-Free High Conductivity) copper, four numbers hard. This was tested along with several other metals. The OFHC alone was found to produce excellent parts, and with tolerances so close as to be almost unbelievable in this type of operation. All other types of copper failed at the very sharp bend where the anchoring lugs join the side of the shell.

An unusual feature of these commutators is the plastic material used in the core. Tough, and unusual in composition, it serves both as insulation and as a mechanical connection between commutator and shaft without use of a bushing and key.

To determine if these commutators could *really* take it, test motors in which they were used were speeded up to 35,000 rpm. Although the wiring in the rotors practically exploded at that speed, there were no failures in the commutators, Temperature tests up to 400° F. were also made. Here again there was no damage to the commutator, though the rotor wiring was badly damaged due to the combination of centrifugal force and decrease in wire strength. Once again the unusual combination of properties of Revere OFHC copper had played a part in helping another one of the country's leading manufacturers produce an outstanding product at less cost.

Perhaps this or some other Revere Metal can be of help in improving your product—cutting your production costs. Toward that end we suggest that you get in touch with your nearest Revere Sales Office.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, New York

• • •

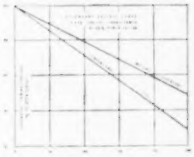
Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.
Sales Offices in Principal Cities, Distributors Everywhere.

The inside story about

MOLONEY *HiperCore* DISTRIBUTION TRANSFORMERS

The inside story about Moloney HiperCore Transformers is centered around the material used in the cores. By using highly efficient oriented silicon steel it is possible to work the cores at higher flux densities than formerly. With the *total* flux requirements remaining practically unchanged, working the oriented steel at higher densities than practical with ordinary silicon steel, results in smaller cross-sectional areas of cores with a consequent reduction in weights.

The smaller cores permit the use of smaller windings, smaller tanks and less oil. This results in lighter weight and smaller transformers which are easier to install and handle generally, and take up less space on the poles. Reductions in size and weight have been made without sacrifice in all-around performance. In fact, HiperCore Transformer operating characteristics are better . . . voltage regulation has been improved . . . greater short-time overloads can be carried.

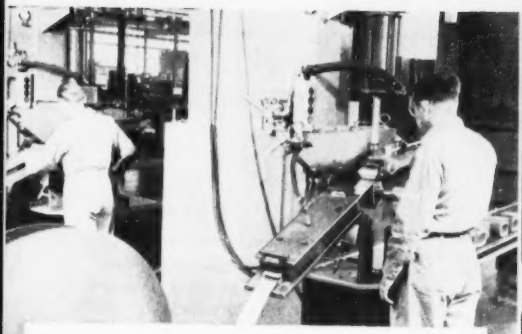


Illustrated are a few of the operations involved in the manufacture of HiperCore Transformers indicating the careful attention given to every detail in order to assure unexcelled on-the-job performance.

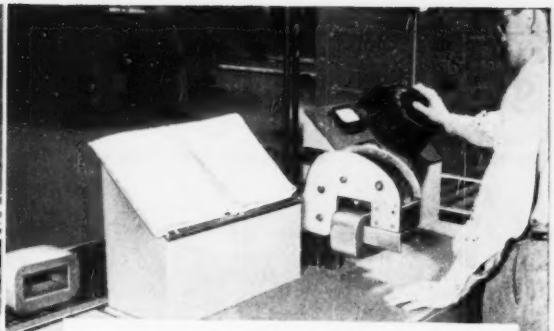
ME49-10

Testing voltage ratios at various tapchanger settings, to make certain that tap leads have been connected to proper studs, and that inter-coil connections are correct.

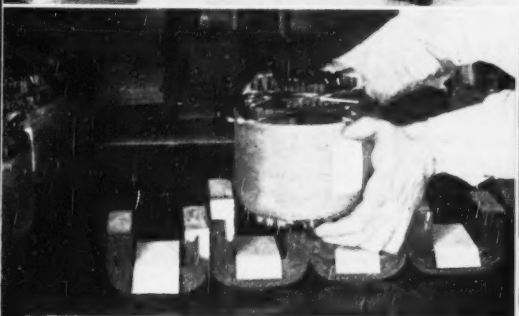
Placing core-and-coil assemblies in tanks after they have passed through oven which removes any moisture which may have been absorbed from the air, and also cures adhesive on core faces.



Cores are wound of oriented silicon steel. Winding machines are semi-automatic, stopping when proper thickness of winding is reached. End of core strip is spot welded.

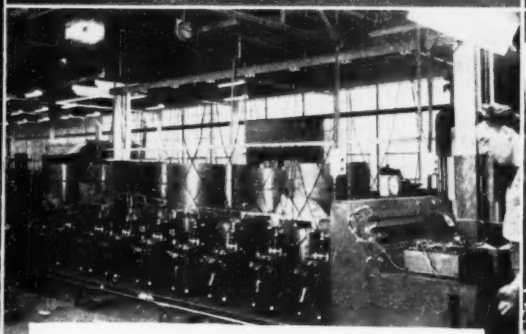


Following winding of the cores, they are annealed in bell-type furnaces in a nitrogen atmosphere and are then given an initial test for losses as illustrated above.



Placing windings into position over U-shaped core pieces. Prior to this operation, cores have been impregnated, baked, cut, etched, and tested a second time.

Connecting tap leads from winding to tapchanger studs. On opposite side of assembly line, terminals are brazed to low voltage leads. Previous operations included applying adhesive to core faces, banding core pieces, and attaching frames.



After bushings have been installed, the tanks filled with oil, and the transformers vacuum treated to remove any entrapped air from the oil or windings, final electrical tests are made.

MOLONEY

ELECTRIC CO.

Sales offices in all principal cities

FACTORIES AT ST. LOUIS 20, MO. AND TORONTO, ONTARIO, CANADA

Safety in Arc-Welding Operations

Some suggested rules and references on safe welding practices and health of welders

A—Personal Protection

1. Do not strike an arc without first having face shield or helmet protecting the face and eyes. Anyone in vicinity of the arc should also be protected.

2. Wear skull cap under helmet.

3. Make sure the face shield or helmet is light-tight and adequately protects the eyes, head, face and neck.

4. When chipping slag, use chipping hammer or pneumatic chisel and have goggles on. Hold one hand over head of hammer or chisel as a shield to prevent particles of slag from flying.

5. Wear good leather gloves of the gauntlet type. Wet or worn gloves have lost all protective qualities and should not be worn.

6. Wear high-top shoes to prevent weld spatter burns on feet and ankles.

7. Weld in a dry place and with dry equipment. If conditions are otherwise, supervising personnel with authority should approve the operations.

8. Keep shirt sleeves buttoned and pockets closed to avoid catching weld spatter which could cause burns.

9. Inspect personal protective equipment before beginning operations.

10. Treat all electrical circuits with the utmost respect. This includes not only the welding machine, but portable electric tools, lights, blowers, etc. Do not remove light bulbs without turning off current. Exposing yourself to electric voltage does not develop immunity. Keep dry and use special precautions to insulate the body when clothing is wet from perspiration or moisture.

11. Weld with a fully insulated electrode holder.

12. Remove electrode stubs from the holder only when the body is not in contact with the work.

13. Do not weld in any confined quarters without installing positive ventilation to assure a good current of fresh air being supplied.

14. When welding or cutting brass, bronze, galvanized steel, cadmium-coated steel, or metals coated with lead or zinc-bearing paint either indoors or in open air, make sure that appreciable quantities of the fumes are not breathed. An individual suction air line or a good respirator will provide protection.

15. In laying down holders or hanging them up when not in use, put them in places where they will not come in contact with other workers or holders.

An adaptation from a paper "Arc Welding-Safely Speaking" by W. W. Reddie, Westinghouse Electric Corp, Buffalo, N. Y., before National Safety Congress, Chicago.

B—Equipment and Welding Circuits

1. Keep welding leads and primary power leads clear of ladders, passageways or doors. Keep leads and cables used for power service to portable welders out of places where there is possibility of machines or trucks running over them.

2. Repair or replace defective cable immediately. Use insulated cable connectors of the locking joint type, having capacity no less than that of cable.

3. Do not allow power supply cable used for portable welders to become tangled with the welding cables or to be near enough to the welding operation to sustain possible damage to the insulation from sparks or hot metal.

4. Do not weld without all electrical connections, power supply, welding leads, holder and ground clamp being secure and the welding machine frame well grounded. The work clamp must be securely attached to work before any welding is carried on.

5. Disconnect welding machine from power supply when leaving unattended.

C—Fire Prevention

1. Weld only in authorized areas.

2. Do not weld without removing combustibles or flammables from the vicinity. If impossible to avoid welding in areas where combustible material is present, as may be the case in maintenance operations, post a watch for at least 30 min after cessation of welding to watch for smoldering fires.

3. Place stub ends of electrodes in metal containers to prevent accidental body burns or fires.

4. Have a fire extinguisher available.

5. Any container that has held flammable material should be thoroughly washed out or steamed. Then fill the container with water and drain down to a point just below where the welding is to be done. An opening should be provided to allow steam or air to escape. Welding should not be started on jobs of this type without permission from the proper supervisor.

6. It is advisable to remove the fuel tank from any motor-driven vehicle before any welding is performed. If this cannot be done, protect the tank and fuel lines adequately from spatter by asbestos boards, asbestos paper or asbestos blankets.

References

Some Standards and Codes applying to and containing valuable information on safe welding practices are:

Electric Arc Welding Machines and Electrode Standards Publication No. 45-105, September, 1945; National Electrical Manufacturers Association, New York 17, N. Y.

Safety in Electric and Gas Welding and Cutting Operations; American War Standard Z49.1-1944; American Standards Association, New York 17, N. Y.

National Electrical Code—1947; National Board of Fire Underwriters; New York, Chicago and San Francisco.

Electric Welding—Safe Practices, Pamphlet No. 105; National Safety Council, Inc; Chicago 6, Ill.

American Standard Safety Code for the Protection of Head, Eyes and Respiratory Organs, Z2-1938; (National Bureau of Standards Handbook H24)

American War Standard Specifications for Protective Occupational Clothing, L-18; American Standards Association, New York 17, N. Y.

Publications

Among the recent publications referring to health of welders are:

Minerals Used in Welding: Ralston and Von Bernewitz; U. S. Bureau of Mines, June, 1940.

Pathology of Shielded Arc Welding: Van Haam and Groom; *Journal* Industrial Hygiene and Toxicology; Baltimore 2, Md, February, 1941

Health Aspects of Welding: Cranch and Vosburgh; 1942, Safety Reprint General No. 5, National Safety Council, Chicago, Ill.

Health Control in Welding: Philip Drinker; *California and Western Medicine*, San Francisco 8, Calif., July, 1943.

Shipyard Health Problems: Philip Drinker; *Journal* Industrial Hygiene and Toxicology, Baltimore 2, Md., March, 1944

Welding Fumes in Steel Fabrication: Drinker and Nelson; *Industrial Medicine*, Chicago, Ill., September, 1944.

Health of Arc Welders in Steel Ship Construction: Public Health Bulletin No. 298, 1947; Supt of Documents, Washington, D. C. (55 cents per copy).

VENTILATED *Copper Angle Bus*

provides Maximum Heat Dissipation

WHEN ANGLE SQUARE HOLLOW BUSSES are installed with surfaces at 45 degrees to the horizontal, a streamline effect is obtained in air movement around the angles. Rate of heat dissipation is thus increased, and correspondingly greater current density is achieved.

This factor, however, is but one of many which must be considered in selecting the most effective bus conductor shape. Location, space requirements or current characteristics may dictate the use of bars, tubes, channels or cables.

Regardless of *shape* decided on, the *metal* to use is *copper*. Combining high thermal and electrical conductivity with strength, toughness and corrosion resistance, copper is generally recognized as the most satisfactory bus material.

Anaconda Copper Bus Conductors are furnished in any of the shapes listed. For detailed information, consult our Technical Department, or write for Publication C-25. 47181

BARS require minimum space, may be bent or twisted, connected to apparatus without special joint preparation and in laminated construction have unlimited d.c. capacity.

TUBES provide the highest bus conductor efficiency at a.c. frequencies, have greater rigidity, and may be oil or water cooled.

CHANNELS have large surface area, reduce temperature rise, provide greater rigidity than tubes for long runs and have flat surfaces for tap-off.

ANGLES for ventilated hollow busses have highest rate of heat dissipation, handle greater current density, but require more space for installation.

CABLES solve many problems in conducting extremely heavy currents in confined space or in connecting moving apparatus such as furnaces of the arc or resistance types.

ANACONDA
from mine to consumer

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BUS CONDUCTORS

THE AMERICAN BRASS COMPANY
General Offices: Waterbury 88, Connecticut
Subsidiary of Anaconda Copper Mining Company
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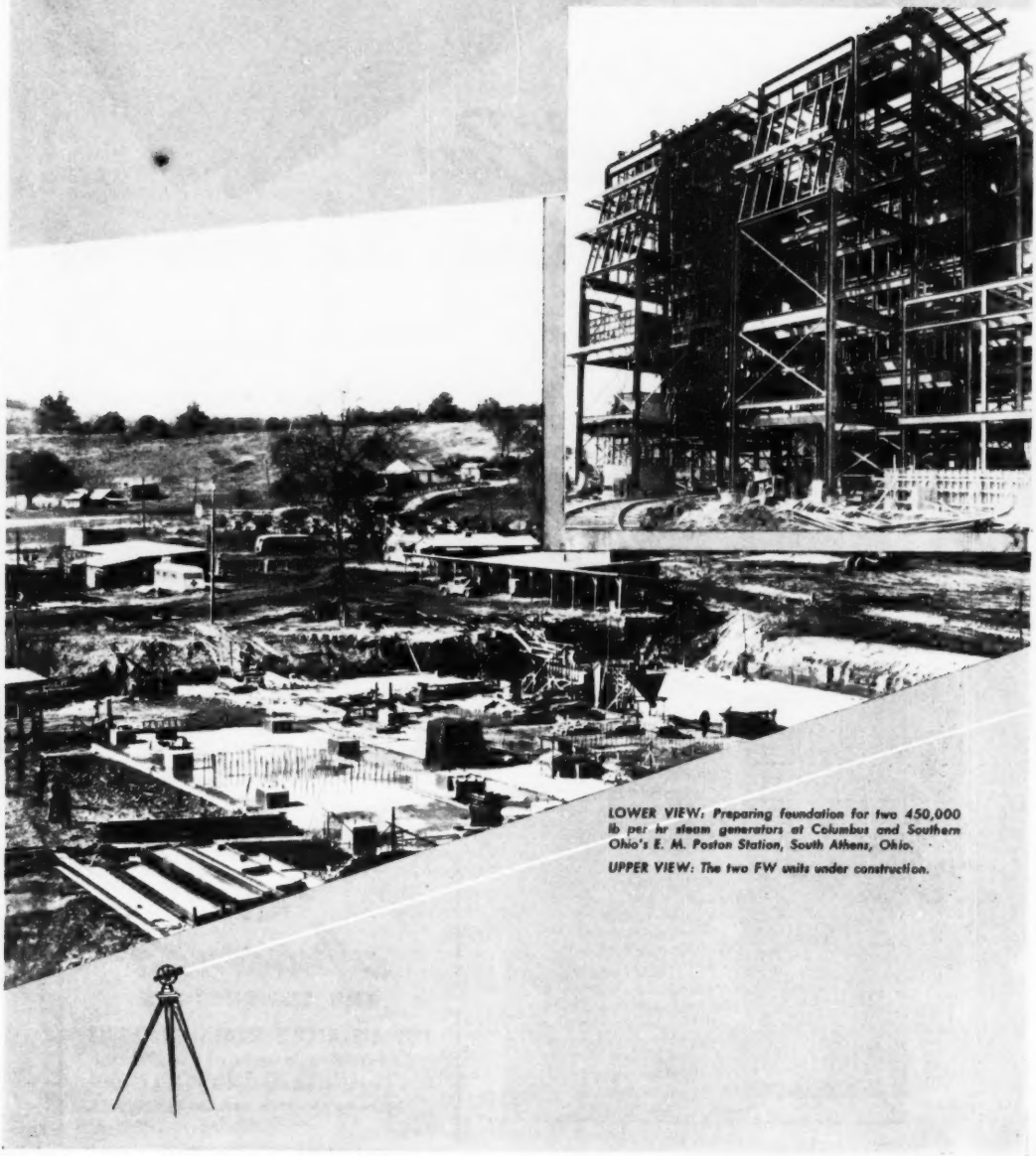
New Toronto, Ont.

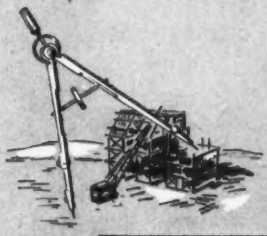
...AND A THIRD

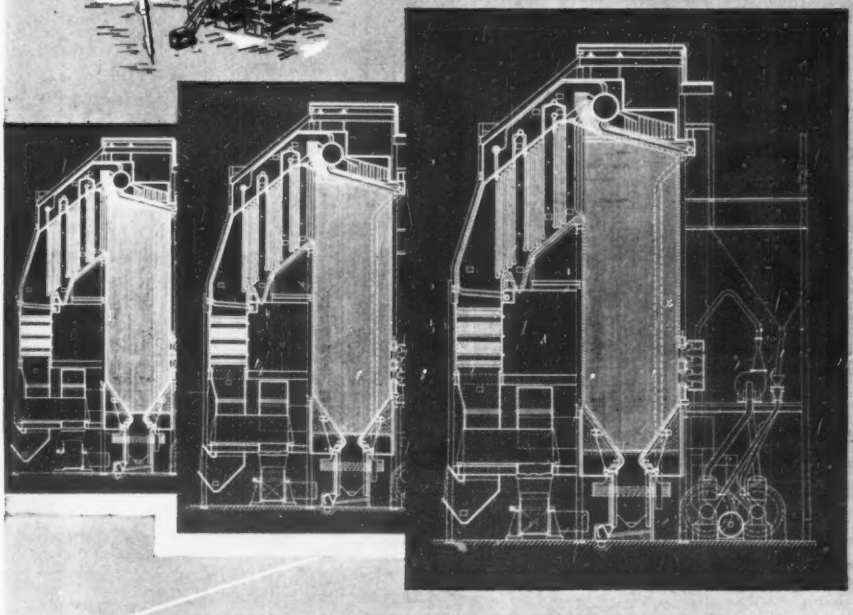


LOWER VIEW: Preparing foundation for two 450,000 lb per hr steam generators at Columbus and Southern Ohio's E. M. Poston Station, South Athens, Ohio.

UPPER VIEW: The two FW units under construction.

UNIT ON THE WAY





A DESIGN WHICH PROMISES FIRST COST SAVINGS AND LONG RANGE ECONOMY

Two Foster Wheeler steam generators with a combined steam capacity of 900,000 lb per hr are now being erected at Columbus and Southern Ohio's E. M. Poston Station, located at South Athens, Ohio.

A third and larger unit of the same design, recently ordered, will have a capacity of 625,000 lb of steam per hr.

These units are typical of the single-pass design which Foster Wheeler is using as the basis for "Preferred Standard" steam generators. This standardized steam generator pattern with fixed individual equipment details may be readily applied to a series of single or twin furnace units, varying in capacity from 300,000 lb of steam per hr to over 1,000,000 lb per hr. The design also embodies Foster Wheeler features of slag-free furnace arrangement, Foster Wheeler condenser-type steam temperature control, low draft loss, and efficient heat recovery equipment.

FOSTER WHEELER CORPORATION
165 BROADWAY, NEW YORK 6, N. Y

Third Foster Wheeler Unit for
E. M. Poston Station
of
Columbus and Southern Ohio Electric Company

Capacity	625,000 lb per hr
Superheat control range	450,000 to 625,000 lb per hr
Pressure superheater outlet	1350 psi
Final steam temperature	955 F
Bituminous coal pulverized in FW ball mills	

FOSTER WHEELER

Foundations for Wood Poles

IV— Design for Pole Footings and Foundations

THE GROUND in which a pole is set must be able to support the vertical or sinking load and the horizontal or overturning load on the pole. A safety factor of 1 (one) is used for both types of loads.

VERTICAL LOADS

Sinking or vertical load on a pole is composed of the weight of iced wires, the vertical component of guy loads, the weight of transformers and other attachments. The vertical load allowed varies as per pole circumference 6 ft from butt and is given in chart Fig 7. When the pole circumference is not of sufficient size to support the vertical load, pole footings (Fig 9) must be installed. Pole footings shall not be installed on existing poles unless they are observed to be sinking. Pole footing calculations are shown in Example I.

Pole footings (Fig 9) consist of 2 in. treated yellow pine planking; single thickness 12 in. x 15 in. for the small pole footing and double thickness octagonal shape 20 in. across flats for the large footing.

HORIZONTAL LOADS

Overturning or horizontal load on a pole is due to the transverse (wind) load on pole and wires, or the load caused by deadended wires, or a combination of the transverse and deadend loads (angle).

(a) *Transverse Loading.* On straight line construction the pole foundation in average soil is assumed to be as strong as the pole; in quicksand or marsh special reinforcing may be necessary.

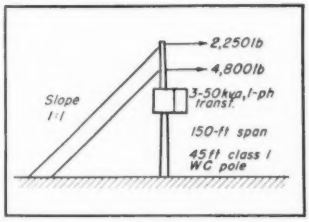
(b) *Deadend Loading.*

(i) FLEXIBLE DEADENDS: Load on flexible pole can be determined from data at office. The moment at the ground line can then be calculated and the type of foundation obtained from Fig 8.

(ii) DEADEND (UNGUYED): For loads of this type, the flexible deadend charts do not apply as the entire lead is flexible.

Determine the load on the end pole by obtaining the heavy loaded tension from tables (at office) for a span length equal to the average of the last three spans and for sag at which the lead is sagged. From this load the ground line moment can be obtained and the pole foundation determined from Fig 8. Pole foundation calculations are outlined in Example II.

(c) *Angle in Lead.* Calculations for determining the moment at the ground line for an unguyed pole at an angle can be obtained from office data (moment on pole at angle). A safety factor of 1 (one) is used for both transverse and longitudinal loads in the design of the foundation. For design calculation see Example III.



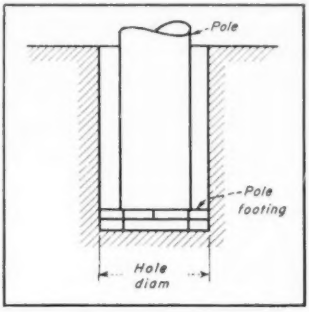


FIG 9—POLE FOOTING. Hole is 22 in. across for large footing and 18 in. for small

EXAMPLE I

Given: New construction as indicated in topmost sketch.

Find: Whether pole requires a pole footing.

Solution: (Detailed data obtained at office)

Vertical load on pole:		
Weight of 3-50 kva, 1-ph transformers	=	3,900 lb
Weight of 40-ft, Class 1, WC pole	=	1,500 lb
Vertical guyload (2,250 and 4,800)	=	7,050 lb
Ice load on:		
3-No. 1/0 wp conductors, 75 ft (half span)	=	252 lb
3-No. 6 wpx conductors, 75 ft (half span)	=	146 lb
Total vertical load	=	12,848 lb

On the chart (Fig 7) the intersection of the lines of the vertical load and the groundline circumference of a 40-ft, Class 1, WC pole falls into the area denoting that a large pole footing would be required (Fig 9).

EXAMPLE II

Given: Two No. 6 primary conductors, 35-ft deadend pole, average 125-ft span (last 3 spans), twice normal sag.

Find: Type of pole foundation required to hold deadend load.

Solution: (Detailed data obtained at office)

Heavy loaded tension for two No. 6 conductors, 125-ft span, sagged twice normal	=	1,060 lb
Moment at ground line, 1,060 multiplied by 28	=	29,680 ft-lb
Multiplied by safety factor	=	1
Total moment at ground line	=	29,680 ft-lb

From Fig 8, this 29,680 ft-lb load will require a log heel and stone toe foundation (Fig 2).

EXAMPLE III

Given: Three No. 2 weatherproof primary conductors, sagged normally. Adjacent spans 175 ft long. Lead turns through a 15-deg angle. 40 ft, Class 3, MC pole.

Find: Type of foundation required to prevent overturning.

Solution: (Detailed data obtained at office)

Moment at ground line due to:		
Wind on wires	=	8,738 ft-lb
Wind on poles	=	1,915 ft-lb
Resultant longitudinal tension of wire	=	33,150 ft-lb
Moment at ground line		43,803 ft-lb
Multiplied by safety factor		1
Total moment at ground line	=	43,803 ft-lb

From Fig 8, the 43,803 ft-lb load will require a log heel and stone toe foundation (Fig 2).

An adaptation from overhead lines standards of Detroit Edison Co; concluding a four-part serial which began in ELECTRICAL WORLD, Page 92, June 4, 1949. Illustrations have sequence numbering throughout the series of articles.

POWERS GENERAL SERVICE BODIES

The versatility of these POWERS Bodies permits them to be used for gas, telephone, water and electric service; street light maintenance, and other types of general service work. Large, weather-tight compartments are fitted with shelves, parts bins, and material hooks to provide facilities for the tools, supplies, and equipment required on almost any job. Standard models are available for installation on ½, ¾, and 1 ton chassis.

POWERS Bodies are also available for construction, maintenance, and service operations in all phases of the public utility industry. Write for complete information.

SERIES 700-C — Forestry Body. Crew compartment comfortably accommodates four men. Winch and derrick optional.

AD-10—Pole Dinkey. Has 1 ton capacity. Other models having capacities up to 5 ton are also available.

SERIES 500 — Line Construction and Maintenance Body. Various models are available for all standard truck chassis.

ALL-STEEL POWERS Public Utility Bodies

UTILITY BODY DIVISION

McCABE-POWERS AUTO BODY CO.

5900 N. BROADWAY • ST. LOUIS 15, MO.

Automatic Throwover Scheme of Duplex Unit Subs

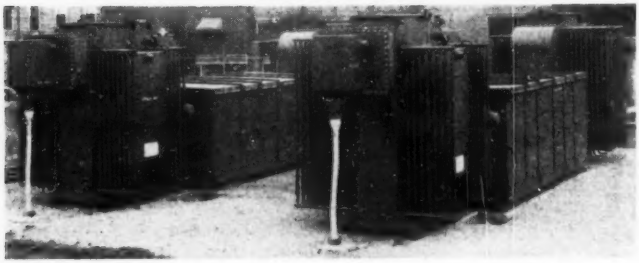


FIG 1—DUPLEX SUBSTATION rated at 3,000 kva, 13.2–4.16 kv consists essentially of two single-feeder radial substations linked by a feeder tie circuit breaker

R. SIEGEL
Switchgear Div
General Electric Co
Philadelphia, Pa.

UNDERLYING the high degree of service reliability attainable with a recently developed duplex type unit substation is the ingenious relaying scheme used to achieve automatic throwover and thus drastically reduce outages due to interruption in primary power supply. The circuit is shown in the accompanying diagram.

An automatic duplex unit substation consists essentially of two single-feeder radial substations linked by a feeder tie circuit breaker. Each radial substation, of course, has its own incoming line, power transformer, and automatic reclosing feeder circuit breaker. Each feeder circuit is normally supplied by its associated power transformer. However, automatic throwover features of the feeder and tie circuit breakers are so arranged that in case only one power transformer is energized, both feeder circuits are supplied from it. All automatic-reclosing feeder equipment also operates, in the usual manner, to reconnect the feeder to its associated power transformer a limited number of times after it is disconnected due to a fault. Hence, maximum reliability is provided to both of the two outgoing feeders either with both transformers energized or with only one of them energized.

Under normal automatic operation with both transformers energized, both voltage relays 47.1 and 47.2 are in the energized position, the two feeder breakers 52.1 and 52.2 are closed and the tie breaker 24 is open. Each of the circuit breaker operations is dependent upon the presence of voltage on the opposite transformer in order to prevent unnecessary circuit breaker operations on simultaneous voltage failure on both transformers. Also the closing of tie breaker 24 will not take place at any time if one of the feeder breakers is open due to a feeder fault.

One Feeder Out

When the station is operating with one of the feeder breakers open, due to loss of voltage to its power transformer, and normal voltage returns, its respective voltage relay 47.1 or 47.2 picks up to close its feeder breaker. Action of this breaker closing trips the tie breaker. In-as-much-as these stations are designed to be fed from synchronous sources, momentary paralleling of the two transformers upon restoration of voltage to the circuit that has been de-energized is desirable and permissible, thus preventing a power interruption at the time of the transfer back to normal conditions.

Both Feeders Out

If voltage is lost on the second transformer after it has already been lost on the first, no automatic operations will take place at the time and neither the second feeder breaker nor the tie breaker will change positions. The voltage relay 47 of the first transformer has dropped out and has opened the trip circuit to the second breaker to prevent tripping from its own voltage relay 47. When voltage returns to the second transformer out, the station will operate as it did prior to this outage. If voltage had returned instead to the first one out, then the second feeder breaker will trip, the tie breaker remains closed the first feeder breaker will close. If with both transformers de-energized and with one feeder breaker open and the tie breaker closed, voltage returns to both lines simultaneously, the other feeder breaker closes immediately and the tie breaker trips, restoring normal operation.

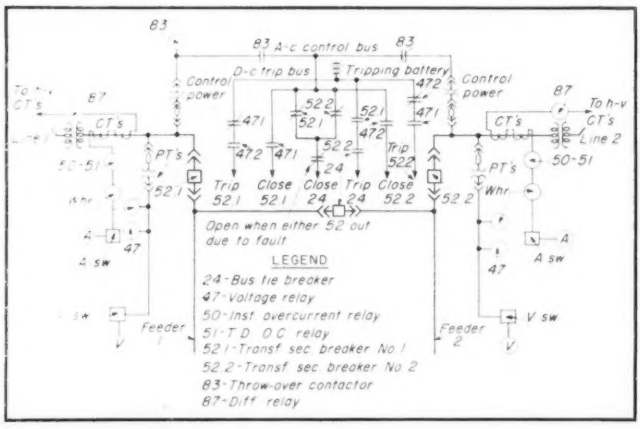


FIG 2—THROWOVER SCHEME using novel relay circuit permits either primary feeder to supply both substation transformer, through automatic operation of the feeder tie breaker. Scheme restores normal dual feed upon restoration of voltage on interrupted feeder

HI-TENSION NEWS *Junior*

While the original cap and pin suspension insulator was introduced by O-B in 1910, O-B's invention of the Treated Sanded Surface in 1917 obsoleted previous designs and established this date as the real beginning of modern suspension insulator manufacture. We illustrate here the first line ever to use this insulator, built in 1917. Today, it is still a major power artery feeding an important metropolitan district. Its performance is wholly satisfactory, as yet giving no indication of any time when re-insulation will be necessary.

There can be a world of difference between a NEW and an OLD Suspension Insulator

Just as much difference as between GOOD and BAD

● Everything you KNOW about a suspension insulator relates to a NEW one—everything you WANT relates to an OLD one!

Industry standards assure you a product of specific characteristics from reputable manufacturers—only when new. No standard or no test can take this new condition and project it 30 years or more into future performance. Here is where the basic difference in suspension insulators shows up.

Today is the "future" which millions of O-B suspension insulators have attained. Lines are still giving normal service with O-B insulation installed between 1917 and 1920.

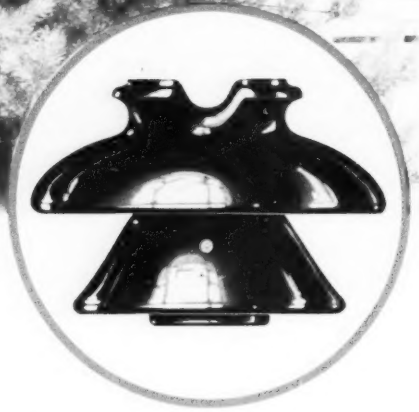
Honestly, there is only one answer to the question, "Will these insulators last 30 years or more?" We must wait that long to find out. Today, we can answer that question. We have waited those 30 years. Users can prove from their own records that O-B suspension insulators show the lowest depreciation rate over long periods of time. You, as a user, can have this assurance of unmatched performance when you insulate your transmission lines with O-B.

Ohio Brass

MANSFIELD, OHIO, U. S. A.

HI-TENSION NEWS *Junior*

The *SMALLEST COST* of a Pintype is its purchase price



On first thought, this may not make sense, but it's a fact—the smallest amount you'll probably ever spend on a pintype insulator is the money to *buy* it.

If the insulator ever requires special attention from an inspector, his trip may amount to several times that insulator's cost.

If a line crew must be dispatched on a trouble call, this might easily buy 50 insulators.

If the insulator ever causes a service outage, lost revenue will pay for it several times over. Put your own price on customer ill-will.

This is just another way of pointing out that pintype insulators are extremely cheap until they cause trouble. Then they get outrageously expensive!

You can't detect any outward difference, but every item in the O-B pintype line is always under laboratory scrutiny for greater resistance to lightning and thermal damage. O-B pintypes have what it takes to *remain* one of the cheapest parts of a power line.

A "Thoroughbred"

FOR URBAN AND RURAL DISTRIBUTION DEADENDS

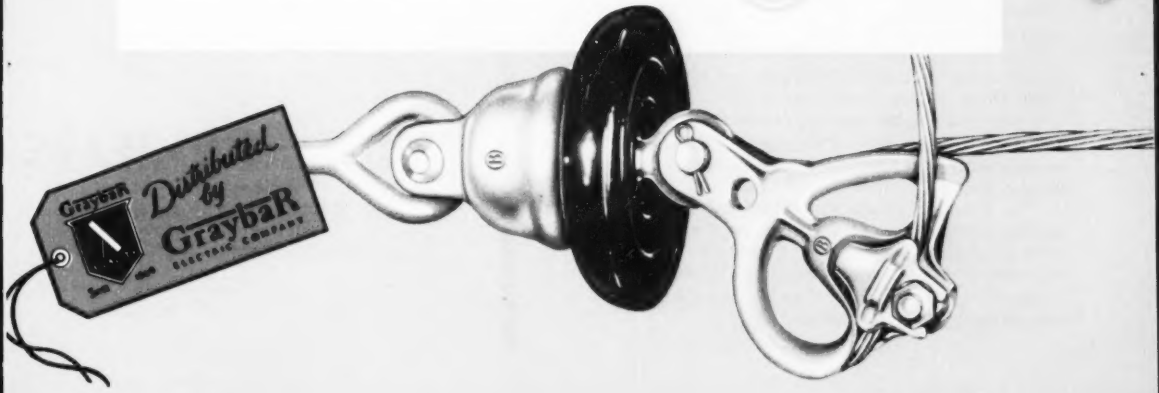
HERE is the basic component for the most efficient and modern deadend used in urban and rural distribution—the six-inch O-B suspension insulator unit. Today, it may be purchased from warehouse stock in over 100 cities throughout the country, via the nationwide service of Graybar Electric Company. This insulator, in great demand and until recently in great shortage, is now available for prompt shipment as a result of O-B's expanded production facilities.

Other than physical size, the six-inch O-B unit is equal in every way to the unit used in high voltage transmission. It has strength to spare. It is engineered for freedom from thermal damage. In short, it is a thoroughbred!

These qualities that add up to lack of operating troubles are urgently needed in distribution deadend construction where both service delays and human hazard are at stake. The best deadend uses the six-inch suspension unit, and the best of these units can be purchased through Graybar—bearing the "O-B" seal.

Ohio Brass

MANSFIELD, OHIO, U. S. A.



HI-TENSION NEWS *Junior*

OHIO BRASS COMPANY

BARBERTON DIVISION • BARBERTON, OHIO, U. S. A.

TO: **THE OKONITE COMPANY**

FOR: **GEORGIA POWER COMPANY**

To conduct 110 kv through part of the City of Atlanta, Georgia, where right-of-way for high voltage overhead transmission would be impossible, an Oilostatic high-pressure pipe-type cable system is employed for the 4.8-mile circuit.

Special O-B Terminal Potheads are required for the cable which operates under a constant 200-pound oil pressure. These potheads must add to their normal function of a 110-kv bushing the ability to resist this high oil pressure on the porcelain parts and joints. This calls for skillful engineering, plus O-B's ability to master difficult special applications of porcelain insulation.

The Okonite Company, manufacturers of Oilostatic cable, points to some interesting features of this installation at the Georgia Power Company: "Circuit rating, 75,000 kva at 393 amperes. Insulation thickness, 0.465-inch. Conductor size, 350,000 cir mils. Three conductors in a single pipe, 5-9/16 inch diameter" . . .

AND (B) POTHEADS

AN ESSENTIAL PART OF OILOSTATIC CABLE

2970-H

Alternatives are Cheaper Than Brick for Walls

RAY N. BENJAMIN
Georgia Power Co
Atlanta, Ga.

SEARCH FOR SUBSTITUTES for bricks in construction today is purely a matter of cost or economics. In 1916 40¢ per sq ft of wall surface was the cost of building a 12-in. brick wall. This corresponds to a total cost of about $20 per thousand for brick in the finished structure. The same source gives 1,200 to 1,500 and more as the number of bricks which would be laid by a brick mason in a day. In 1940 brick construction could be done at a cost of about $40 to $50 per thousand bricks in place, or 30¢ to $1.00 per sq ft of 12-in. wall.

Cost Increased Tenfold

In working up the design of a new steam plant we were faced with an estimated cost of about $200 per thousand for brick work, or $4 per sq ft of 12-in. wall if brick construction should be used for the power house walls. This led to an investigation* of the matter of using some other material. It was necessary to go out and search for materials and types of construction which might be suitable alternatives. Information regarding several materials was compiled among which were: "Q" panels, "C" panels, Cemesto and Transite.

Insulated "Q" panels are manufactured by H. H. Robertson Co of a flat and a fluted sheet of metal with a 1½-in. thick Fiberglas board between. The panels may be fabricated from Galbestos, aluminum, stainless steel, galvanized steel or black steel. Cost is from $1.30 to $2.30 per sq ft erected, depending upon the material from which the panels are made.

The same producer also offers various combinations of sandwich type construction at costs ranging from about $1.25 to $1.60 per sq ft erected. Corrugated Galbestos and RPM materials cost from about 52¢ to 55¢ per sq ft erected.

Fenestra Type "C" panels are manufactured by Detroit Steel Products Co. The panels are formed of two flat sheets, which may be of steel, aluminum, or a combination of each, with 3 in. of Fiberglas insulation between the sheets. Cost erected runs from $1.50 to $2.35 per sq ft.

Cemesto is manufactured by the Celotex Corp. It consists of two flat ½-in. thick cement asbestos boards, between which is bonded a Celotex cane fibre insulation. It costs from 45¢ to 55¢ per sq ft erected.

Corrugated Transite is manufactured by Johns-Manville, and possibly by other companies. It is made of asbestos fibre and cement, formed under pressure, to produce rigid sheets, approximately ⅜-in. thick. Estimated cost erected will be about 45¢ to 55¢ per sq ft.

It is also possible to obtain walls consisting of corrugated sheets of Transite on the outside and flat sheets of Transite inside with 1 in. of insulating board installed between the sheets. This would cost about 75¢ to $1 per sq ft.

Jumbo Brick is a brick manufactured in several sizes at about 30¢ per brick. Since only six bricks are required to lay up a cubic foot of wall, or a square foot of 12-in. wall, the cost of a 12-in. wall of Jumbo Brick is $1.30 per sq ft.

Load-bearing Tile

It is estimated the exterior walls can be constructed with 8-in. load bearing tile (such as Speed-A-Backer tile) and a 4-in. face of ordinary brick at a cost of about $2.20 per sq ft of completed wall.

When most substitute materials are used it is necessary to employ steel girts or some similar type of construction for supporting the siding. Principal increase in building steel tonnage due to the use of the substitute materials is in the girts, and possibly in additional bracing which may be required. The total increase in cost of steel work probably is not a relatively great item, and since the estimates of cost of various materials are not intended to be very precise, this item has not been included in the figures given above.

These studies were made during the fall of 1948 in connection with the preliminary design of Plant Yates, the new 200,000-kw steam plant near Newnan, Georgia. It was estimated that a total wall surface of about 50,000 sq ft involved in the power house construction could be changed from brick to some other type of construction. This does not take into account the temporary end which would not be constructed of brick in

* Adapted from paper at recent meeting of the Southeastern Electric Exchange Engineering and Operations Section in Savannah.

Here's an appraisal service in one convenient package

You can buy an appraisal service that's designed to meet your individual needs. It covers both "rate-base" and "property" appraisals. It is available in one convenient, economical package, either complete or including only those phases that you require . . .

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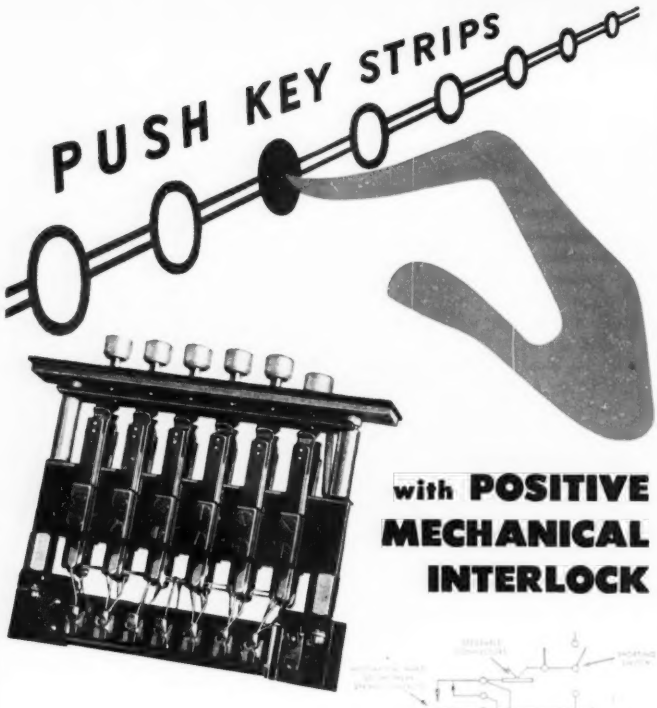
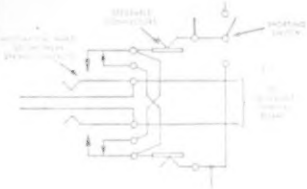


with POSITIVE MECHANICAL INTERLOCK



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You'll get simple, safe, positive operation in multiple circuit controlling and switching with Power Equipment Push Keys. Developed for a wide range of communications applications, they're designed around a foolproof mechanical interlock which effectively prevents dual operation. By a patented system of cams, it is impossible for two keys of any one strip to be in depressed position at the same time. One key is automatically disengaged before a second key can be locked into place or make its contacts. Simple, compact, self-restoring. Provides faster, more convenient switching. Eliminates patching cords and cord maintenance. Equipped with separable connectors for easy plug-in type assembly, and colored plastic buttons for quick circuit and equipment identification. Write today for complete information and application data.

POWER EQUIPMENT *Company*

Specialists in Controlled Rectifiers Since 1935

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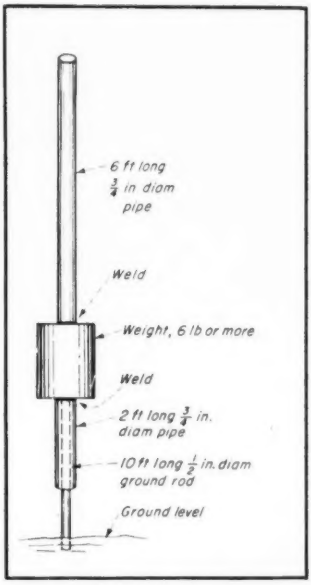
any case, and it does not take into account the office annex and electrical control room, which will be constructed of brick.

After studying the unit costs of various substitute materials, it was decided that corrugated Transite would probably be as satisfactory as any of the other substitutes for brick. It is estimated that a saving of approximately $150,000 will be effected.

Ground Rod Sledge

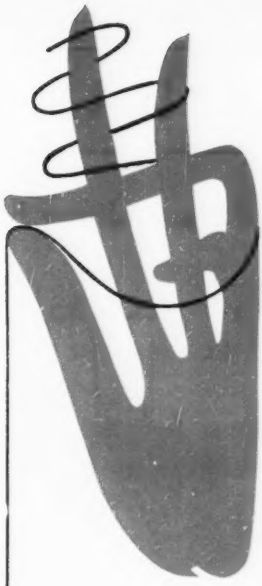


ROD HAMMER for driving ground rods consists of pipe welded to sledge

JACK GIBSON
Gustav-Hirch Organization, Inc
Warren, Ohio

FOR DRIVING 1,500 ½-in. diam ground rods it was necessary to devise a new kind of driving sledge. Power hammers first were tried but bent the rods.

The successful tool has a long and short piece of ¾-in. diam pipe welded on to each end of a weight, as shown. First, the 6-ft length is slipped over the 10-ft. ½-in. diam rod, which is driven until the 6-ft end hits the ground. Then the rod hammer is reversed and the 2-ft length is used. Since most ground clamps must be at least 18 in. below ground level, sometimes they can be attached to the rod before the shorter pipe length touches the ground.



HOSKINS

Chromel

. . the original nickel-chromium heating element wire

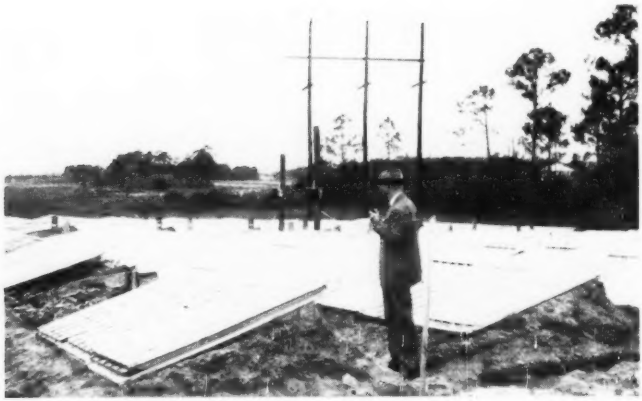
CHROMEL resistance wire is available in B & S gauge sizes from 000 down to .0010 for a wide range of electrical heating and resistor applications.

Wherever you find an electrical heating application . . . in household appliances or in industrial processes . . . chances are you'll find durable Hoskins CHROMEL on the job. For CHROMEL, you know, is the *original* nickel-chromium resistance wire . . . the wire that *first* made electrical heating practical. It gets hot, stays hot, lasts a long time. And, for many good reasons, it's been the basic element of the industry for over 40 years. So whether your interest in electrical heating is from a utility load-building point of view, as a manufacturer of appliances, or as a user of electric heat in your production processes, be assured that your best interests are best being served by Hoskins CHROMEL resistance alloy. Complete technical information plus helpful application data is contained in our Catalog M-1 . . . want a copy?

HOSKINS MANUFACTURING COMPANY
4445 LAWTON AVE. • DETROIT 8, MICHIGAN

LOAD BUILDING

Potentialities of Soil Heating Load



TWO MILLION sweet potato plants are the capacity of these electric hot beds

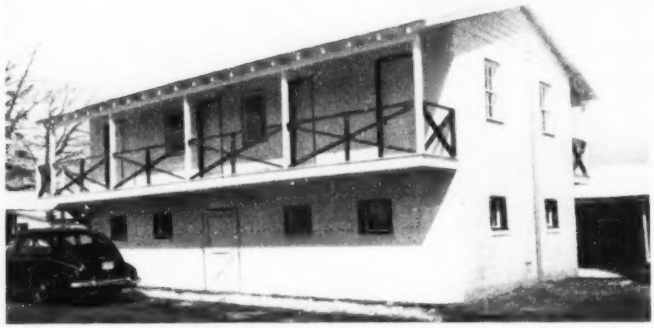
L. W. GRAY
Manager, Rural Division
Georgia Power Co

PRODUCTION of vegetable plants—tomatoes, peppers, sweet potatoes, cabbages and many others—for replanting in commercial and home gardens is a rapidly growing business in Georgia, particularly in the southern part of the state. Contributing importantly to this expanding business is the electric soil heating cable. At first, growers were inclined to be somewhat skeptical about the electric hot bed. That attitude is changing rapidly as the advantages of electric heat in control of plant growth become more widely known among the trade.

To meet production requirements that the young plants will be ready on time for the longest field growing season, commercial gardeners and canners are now demanding specific guarantees of delivery from the growers. Heating cable is helping them to meet such guarantees by maintaining optimum soil temperature for rapid and healthy growth of the seedlings.

Sweet potato plants furnish a good example of how soil heating is applied. About 500 bushels of seed potatoes can be bedded in 700 sq yds of heated soil from which 1,250,000 plants, enough to plant 125 acres, can be taken. The usual area for the standard 60 ft of 110-v cable, rated at 400 w, is 4 sq yds. Thus to propagate 1,250,000 plants a connected load of 70 kw is required. The Georgia Crop Reporting Service says that 58,000 acres of sweet potatoes were planted in the state in 1948. This represents a potential soil heating load of 32,480 kw. Add to this the potentialities of tomato, pepper, cabbage, azalia, camellia and other food and flower plants, and the possible business in soil heating looms up in imposing proportions.

Electric Heat Facilities are Added at Bowie



NEW BUILDING, one of four, to house jockeys and stable help. Each building is equipped with 500-gal, 36-kw electric water heater which delivers a constant supply of water at 140 F

OVER 500 kw in electric heat is being utilized at Bowie, Maryland's famous track. Of that total about 300 kw comprises space heating units. The remainder is for water heating.

Installation of electric heat is part of the extensive changes and additions which have been made since last year. Many new buildings have been erected to provide quarters and more comfortable facilities for track employees, jockeys, stable help and 1,000 horses. Here racers from many parts of the country are boarded during periods between meets at other tracks. Mr. W. R. Watt, construction superintendent, is responsible for in-

"Anaconda" ... always means

Keeping-Ahead-of-the-Parade

TAKE CB* CABLE WITH F-3**
ALLOY SHEATH FOR INSTANCE:

In 1939

Anaconda engineers introduced Type CB cable because ordinary paper-insulated cable wasn't good enough. Carbon-black paper removes oxidation products from the insulation, eliminates ionization discharges. These and other desirable properties increase insulation stability and assure longer cable life.

In 1944

Anaconda engineers added the resilient binder for they had found a way to reduce sheath strain during daily load cycles. Made of special carbon-black paper, it is strong yet resilient, results in lower stresses in the sheath due to cushioning effect, conducts radially and is fully adequate against magnetic forces.

In 1944,

because they know cable life often is shortened by premature sheath failure, Anaconda engineers gave this Type CB cable the amazing F-3 alloy-lead sheath. It is the best all-around alloy ever offered in the industry . . . resists slow-bending fatigue, creep (expansion), bursting, abrasion, vibration fatigue and does not age-harden . . . actually extends sheath life more than three times ordinary sheath. It has truly earned the name "indefatigable."

*CB—Carbon-Black. Trade Mark Registered U. S. Patent Office
**F-3—Arsenic-Lead alloy (U. S. Patents 2,300,788 and 2,374,755)

THIS COMBINATION permits heavier loads for longer life!

ANACONDA
from mine to consumer

ANACONDA WIRE & CABLE COMPANY

25 Broadway, New York 4, N. Y.

ELECTRIC SPACE HEATERS provide comfort for W. R. Watt, construction superintendent. Added safety and convenience of electric heat at Bowie are results of his doings

troducing electric heat at Bowie.

Scattered locations of buildings, fluctuating requirements for heat, investment in a central heating plant and pipe-line system were important factors in the decision to use electric heat. In addition the safety factor is enhanced because stable attendants need not build open fires for warming water to wash their steeds. The inadequate hot water supply often became exhausted. Another improvement is in the policing of the property. Previously boiler rooms in the various buildings were left open so workmen could attend fires. But now the doors are padlocked to prevent hangers-on from sleeping in them. Electric service is supplied by Consolidated Gas Electric Light & Power Company of Baltimore.

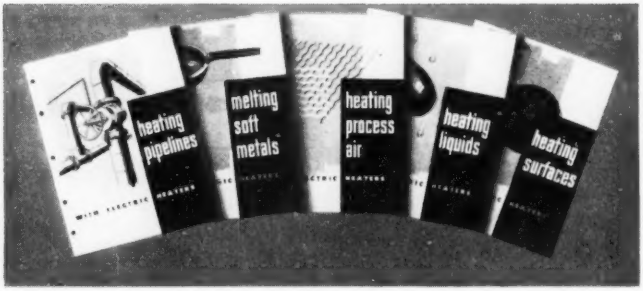
Space Heaters Used Extensively

Installation of space heating equipment involves more than sixty 5-kw units equipped with circulating fans, all thermostatically controlled. The system is designed so that the heaters in the various areas can be energized from a central switch. Space heaters are used in offices, ticket booths, concession buildings, indoor recreation places, and out-of-the-way places such as the judges stand and press stand atop the grandstand.

The water heating system comprises four 500-gal tanks, in four new buildings. Each tank is fitted with immersion units totaling 36 kw and a thermostat to maintain a constant supply of 140 F water.

In addition individual electric water heaters, 1½-kw, 60-gal units, some larger, are installed in stables, living quarters, and other buildings containing wash room facilities.

New MPA Program, "Industrial Heating"



METHODS of applying built-in electric heaters for greater output of higher quality products

A NEW "More Power to America" program designed to show how electric heat, properly applied, can help industry to increase production, provide better equipment designs, and improve product quality has been announced by General Electric Co, Schenectady 5, N. Y.

This program, twelfth in the series, consists of a 25-min, 35-mm black-and-white sound slidefilm, "Heat—Where You Want It", and five different application data booklets covering the major uses of tubular, strip, and cartridge heaters in industrial installations.

Showing actual case histories, the film illustrates how compact electric heaters can be installed as "built-in", functional, space-saving components of machines and equipments. The cases cover a wide range of installations from food-packaging machinery to stereotype-melting pots to indicate the wide applicability of electric heaters in various phases of modern industry.

Application Information Provided

Like the slidefilm, the application data booklets deal with each of the five basic heating applications. They present the fundamentals of incorporating "built-in" electric heat into industrial equipment and machines and provide detailed application information, including necessary data and formulas for calculating heat requirements.

10 WIREMOLD
SURFACE RACEWAY
SYSTEMS

. . . meet the wiring needs of every job.

No. 200
For branch circuits . . . extension from existing outlets . . . or to provide switches or additional outlets.

No. 500
For branch circuits . . . extension from existing outlets . . . or to provide switches or additional outlets.

No. 700
For branch circuits . . . extension from existing outlets . . . or to provide switches or additional outlets.

No. 1000
A branch circuit feeder direct from panel box.

No. 1100
For wiring infra-red ovens . . . show window lighting.

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An over-floor system for light and power and telephone circuits to locations away from walls.

No. 1900
A plug-in-anywhere wiring system for outlet convenience in factories, hotels, offices, apartments, homes, stores, etc.

No. 2100
A plug-in-anywhere wiring system . . . or a distribution system for lighting fixtures.

No. 2600
For interoffice telephone wiring requiring additional circuit capacity.

No. 3000
A branch circuit feeder system direct from panel box to machine tools, lighting fixtures, portable power tools, etc.

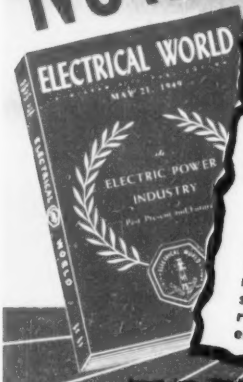
WRITE FOR "WIRING GUIDE"

Know your WIREMOLD

MORE THAN ADEQUATE WIRING

THE WIREMOLD COMPANY
HARTFORD 10, CONN.

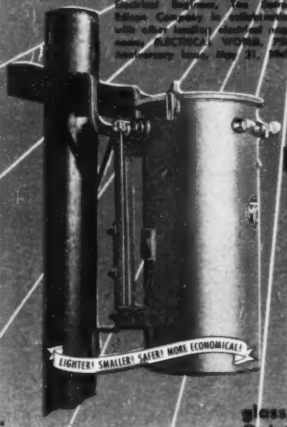
NOW! the transformer of the future



FUTURE POSSIBILITIES

. . . It is to be expected that such activity (improvements) will continue in the future. Much of it can probably not be foreseen at this time. There are a few items, however, which might be mentioned as either distinct possibilities or highly desirable.

There is considerable promise of the production of a dry-type distribution transformer for pole top installation. The advantage will be less weight and lower maintenance. It seems possible that on such a transformer the case might be reduced to a minimum or perhaps be eliminated entirely.



Currently available in sizes to 100 KVA, voltages to 5000 V.

MARCUS
DRY TYPE AIR COOLED DISTRIBUTION TRANSFORMERS

Months before the publication of this excellent article on distribution transformers, Marcus, a pioneer in the field, announced a new line of all purpose dry type distribution transformers for indoor or outdoor service.

The complete absence of hazardous oil or toxic liquid affords safety never before realized. Superior Class B and C heatproof insulation, such as fibreglass, mica, porcelain, new Johns-Manville Quinterra, etc., results in overload capacities unobtainable with Class A oil filled units. The entire transformer element is seal protected against oil, acids, moisture, etc., and is housed in a sturdy, scientifically ventilated, weather proof case which conforms with all applicable EEI-NEMA construction standards. This extremely versatile transformer can be used outdoors, pole or platform mounted or indoors at the load center, mounted wherever convenient with no expensive fireproof vault required.

AIR-COOLED TRANSFORMERS EXCLUSIVELY
1 to 2,000 KVA up to 15,000 Volts to meet Individual Requirements

- DISTRIBUTION
- GENERAL PURPOSE
- UNIT SUBSTATION
- PHASE CHANGING
- ELECTRIC FURNACE
- RECTIFIER
- WELDING
- MOTOR STARTING

Write for Bulletin #49-ACO

COMPETITIVE PRICES — GOOD DELIVERIES

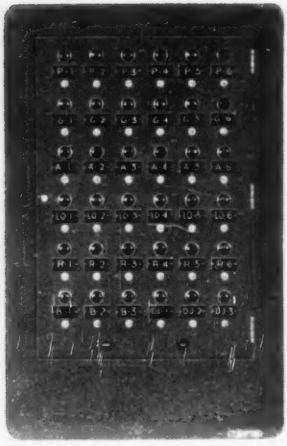
MARCUS TRANSFORMERS CONFORM TO THE STANDARDS OF N.E.M.A. AND A.I.E.E.

Representatives in Principal Cities

MARCUS TRANSFORMER CO.
INC.
32 MONTGOMERY STREET
HILLSIDE 5, NEW JERSEY

PIONEERS IN THE FIELD OF AIR-COOLED TRANSFORMERS

NEW EQUIPMENT



Annunciator

GIVING both visual and audible alarm when trouble develops, this annunciator is manufactured by Auth Electric Co, Inc, 34-20 45th St, Long Island City 1, New York. It is known as No. 1518 Bull's-Eye Lamp Type supervisory annunciator.

Audible alarm (bell or horn) is silenced by switch beneath glowing lamp. Visible signal is reset by push-button at bottom of panel. However, it cannot be deenergized until the operating contactor is restored to normal.

This unit is designed for flush, surface or panel mounting, open or closed circuit operation, on from 24 to 250 v, a-c or d-c sources as specified. It can be supplied with as many indicators as necessary, with identifying cards properly marked.

•

Silver Coating Process

A FAST portable method for applying silver coatings on bus bars and other contacting surfaces of any size has been announced by Rapid Electroplating Process, Inc, 1414 S. Wabash Ave, Chicago 5, Ill. The company advises that this process has advantages which include: No distortion or softening of fittings; no oxidizing of adjacent areas; positive adherence and no porosity; denser coatings can be applied; and is 15 times faster than brush plating.

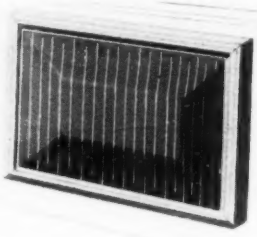
Steps in plating are: (1) Polish surface with fine abrasive; (2) clean and activate with Rapid Metal cleaner, and rinse or wipe off; (3) connect current and apply electrolyte with applicator; and (4) rinse or wipe electrolyte off. No polishing is required after plating.

Plating units are furnished as complete units with power supply or as economy units for use with direct current of 8 to 10 amp at 6 or 8 v from other sources. Units are also available for plating other metals including nickel, tin, zinc, brass and gold.

•

Radiant Heat Panels

DESIGNED to operate at 25% lower cost than comparable radiant heating systems, Electriglas radiant heat panels have been introduced by Appleman Glass Works, Bergenfield, N. J. Physical composition of glass and construc-



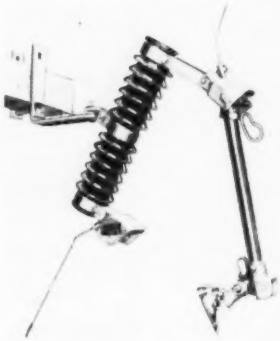
tion of panels are responsible for this increased efficiency, it is announced.

Secret of this system is the metallic alloy grid, fused into Temprex glass which is said to be about 5 to 7 times stronger than ordinary glass and practically indestructible. These panels are safe for use in rooms where children and elderly or sick people are present. Radiant heat panels can be connected with conduit or cable to existing a-c or d-c 110 or 220-v circuits.

•

Fuse Cutout

INDICATING whether it has been opened as a disconnect or blown by a fault, a dropout fuse cutout is manufactured by A. B. Chance Co, Centralia, Mo. If fuse tube of type KM is hanging from lower contact housing, it



has been disconnected. If fuse tube is hanging from upper housing, fuse link has blown.

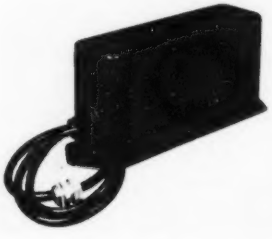
Other features of the cutout include: shielding of all moving parts from ice accumulations; fuse protected against entry of moisture; arc extinction aided by delay of contact separation; contacts protected by overtravel stops; and blast shield protects lineman and reduces danger of ionized gases forming conducting path to mounting bracket.

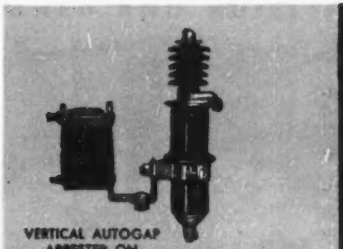
•

Capacitors

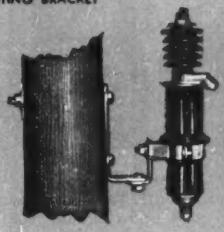
FOR oil field service or industrial plant use, a line of pyranol-filled capacitors is available from General Electric Co, Schenectady 5, N. Y. Suitable for outdoor service, the capacitors come in ratings of 2, 3, 4, 5 and 6 kvar at 460 v.

They can be mounted in any position. Each unit has a 4-ft, flexible flamenol-jacketed cable, including ground wires, with a $\frac{3}{4}$-in. water-tight connector at end of the cable for knockout connection to the motor starter.

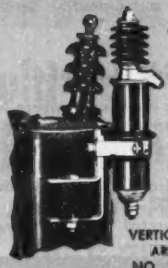




VERTICAL AUTOGAP ARRESTER ON NO. 2337 CROSSARM MOUNTING BRACKET



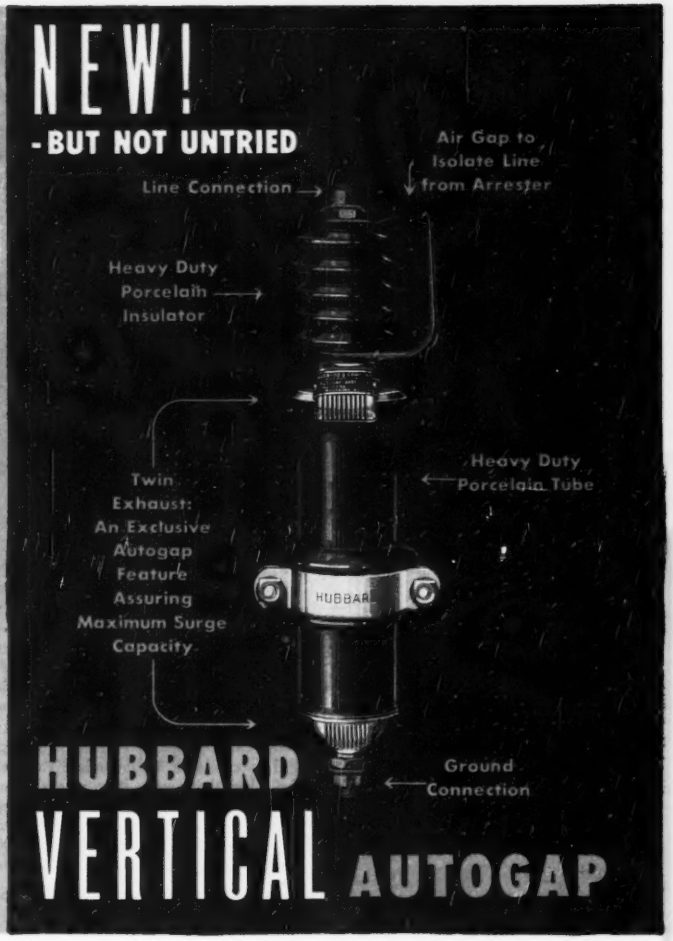
VERTICAL AUTOGAP ARRESTER ON NO. 2338 POLE MOUNTING BRACKET



VERTICAL AUTOGAP ARRESTER ON NO. 2349 TRANSFORMER BRACKET

NEW!

-BUT NOT UNTRIED


Air Gap to Isolate Line from Arrester
Line Connection
Heavy Duty Porcelain Insulator
Heavy Duty Porcelain Tube
Twin Exhaust: An Exclusive Autogap Feature Assuring Maximum Surge Capacity
HUBBARD
Ground Connection

HUBBARD VERTICAL AUTOGAP

When the Hubbard Autogap was originally developed and placed on the market, it was designed for horizontal mounting due to mechanical requirements which seemed best solved by a horizontal installation. At the time, however, it was foreseen that a vertically mounted Autogap would be needed, and work was started on its development.

All the operating advantages of the original Autogap are retained in this new vertical design. Construction is exactly the same in principle and all parts in the one design have a counterpart in the other. The only difference, other than the physical arrangement of parts, is that the process of expulsion acts vertically instead of horizontally.

Many hundreds of thousands of Autogaps have proven their efficiency over a ten year period with no failures resulting from operating conditions, excluding those few which have been put out of service by falling equipment.

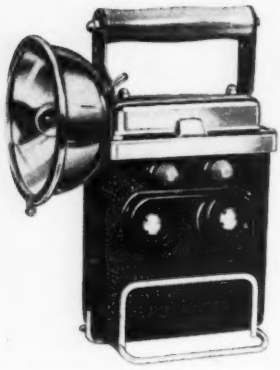
Stock No.	Voltage Rating	Phase Voltages		60 Cycle Flashover	Min. Impluse Breakdown Voltage (1½ – 40)	Approx. Shpg. Wt. Lbs. Ea. Inc. Brkt.
		Grounded	Ungrounded			
2330	3 KV	1 to 5 KV	1 to 3 KV	19 KV	30 KV	11½
2331	6 KV	5 to 9 KV	3 to 6 KV	25 KV	40 KV	13¾
2332	9 KV	9 to 13.8 KV	6 to 9 KV	32 KV	60 KV	13¾

One Bracket furnished with each Autogap. Specify Type.

"hang the LOAD on HUBBARD HARDWARE"

HUBBARD AND COMPANY

PITTSBURGH CHICAGO OAKLAND CALIF.



Rechargeable Spotlight

READY to operate as soon as the electrolyte is poured in, a rechargeable 4-v, two-cell spotlight is available from Koehler Mfg Co, Marlboro, Mass. Electrolyte is furnished in two small, unbreakable containers.

Features of the device include: Battery casing made of Butalite, stated to be 15 times stronger than highest quality hard rubber; total weight of 92 oz; light output rated at 25,000 cp, with a minimum operating time of 1,000 hr; and built-in windows to show level of electrolyte. The manufacturer advises that this spotlight may be recharged from an automobile cigar lighter outlet.

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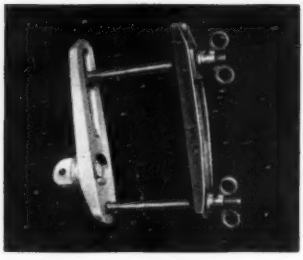


Tong Saddle

FOR USE with wire tongs on underbuilt arms when working space is limited or pole saddles cannot be used, a crossarm wire tong saddle is manufactured by A. B. Chance Co, Centralia, Mo.

Pivoting action of saddle swivel and pole clamp attachment provides a universal joint action allowing freedom of wire tong movement in any direction. Saddle can be attached to crossarms from 3 x $4\frac{1}{2}$ to 4 x 8 in. It will hold pole clamps from $1\frac{1}{4}$ to 3 in. and has a load rating of 500 lb.

Street Lighting Control

SELF-CONTAINED type CSP-C constant-current regulator has all controls and accessories mounted with the tank, according to the manufacturers, Westinghouse Electric Corp. Box 868, Pittsburgh 30, Pa. Time for mounting this unit is cut because only power leads and control line need be connected to bushings provided.

All high-voltage regulator parts and accessories are housed in copper-bearing steel tank. A weatherproof cabinet on the outside of the tank contains a relay control element and automatic-control relay devices.

These regulators are available in 5, $7\frac{1}{2}$, 10, 15, 20, 25 and 30-kw sizes for operation of 6.6-amp secondary from 2.4-kv, 60-c primary. A 2160-v tap permits operation with voltages from 2050 to 2520 v.

•

Sealed Relays

A LINE of hermetically sealed relays, said to provide the ultimate in operating dependability, is manufactured by Automatic Electric Co. 1033 W. Van Buren St. Chicago 7, Ill.

Many types of relays are available in various sizes and shapes of enclosures. In many cases, more than one relay can be enclosed in one housing. Relays available accommodate voltages from less than one volt to several hundred volts. Contact ratings vary from a few milliwatts to several hundred watts. Operate times vary from 1 to 100 millisec and release times from 5 to 500 millisec.

•

D-C Generator

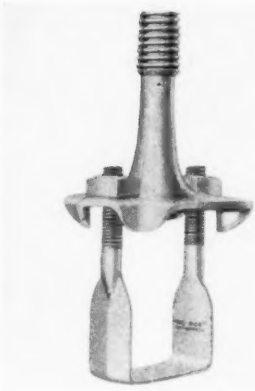
DELIVERING an output voltage proportional to the acceleration of the rotor rather than the velocity of rotation, a servo-type d-c generator has been released by Arma Corp, 254 36th St. Brooklyn 32, N. Y. They are reported particularly suitable in servo systems having severe damping problems and systems where acceleration must be limited or measured.

For a field input of 0.120 amp, these units deliver 0.1 v for an acceleration of 1,400 radians per $sec.^2$ Max speed is 5,000 rpm and rotor inertia is 0.25 $oz\text{-}in.^2$ Weighing 3 lb, the generators are 3.375 in. overall, exclusive of shaft.

•

Corner Pin

DROP FORGED from one piece of steel to a broad base which covers the top of the crossarm, this corner pin made



by Hubbard & Co. 6301 Butler St. Pittsburgh 1, Pa., has no seams, joints or pockets to retain moisture and hasten corrosion.

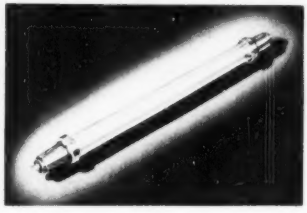
Broad surface bearing insures an even distribution of longitudinal stresses so that maximum strength per weight of metal used is developed.

•

Germicidal Lamps

FOR USE in all areas where low temperatures are a necessity, Zeroline 16-in. and 30-in. germicidal lamps have been announced by Hanovia Chemical & Mfg Co. Germicidal Lamp Div, Newark 5, N. J.

It is reported that, due to construc-



tion size and jacketing, these lamps are effective at near zero temperatures and are not subject to short life and low efficiency common to ordinary lamps. Life of these units is rated at 8,000 hr.

•

Static Pressure Control

FOR APPICATIONS on very low pressures where regulation is required in inches of water (pressure or vacuum), explosion, dust, and splash-proof controls have been added to a line of sensitive static pressure controls made by Coral Designs, Box 248, Forest Hills, N. Y.

Units are obtainable in standard

DESIGNED AND BUILT FOR RUGGED *"Right on the Job"* SERVICE

Multi-Part High Voltage PINCO Pin Type Insulators

. . . are RIGHT on the job because of Pinco assembly techniques

Pinco Wet Plastic Process Porcelain gives these 2- and 3-part pin types unexcelled insulating qualities. Pinco design provides husky sections and beaded edges to eliminate mechanical failure. But here's what makes them unique:

- Pinco secret-formula resilient compounds, applied to the porcelain surfaces in contact with cement, completely relieve the effects of thermal expansion at any temperature encountered in service.
- Pinco cementing processes involve laboratory-controlled mixing techniques, and curing in special rooms where temperature and humidity are rigidly regulated.
- Porcelain sand grains are of uniform size, and are applied in belts of even thickness and width.

These exclusive features may not be apparent to the eye in the assembled unit. But they do reveal their importance in service. That's why "right-on-the-job" specifiers and buyers select Pinco Multi-Part High Voltage Pin Types for *RIGHT on the job* performance.

Pinco Multi-Part High Voltage Pin Types

No. 72 . . . Rated Voltage 35 kv. Dry Flashover 110 kv. Wet Flashover 75 kv.

No. 75 . . . Rated Voltage 45 kv. Dry Flashover 125 kv. Wet Flashover 85 kv.

No. 428A . . . Rated Voltage 55 kv. Dry Flashover 145 kv. Wet Flashover 100 kv.

No. 435 . . . Rated Voltage 66 kv. Dry Flashover 170 kv. Wet Flashover 130 kv.

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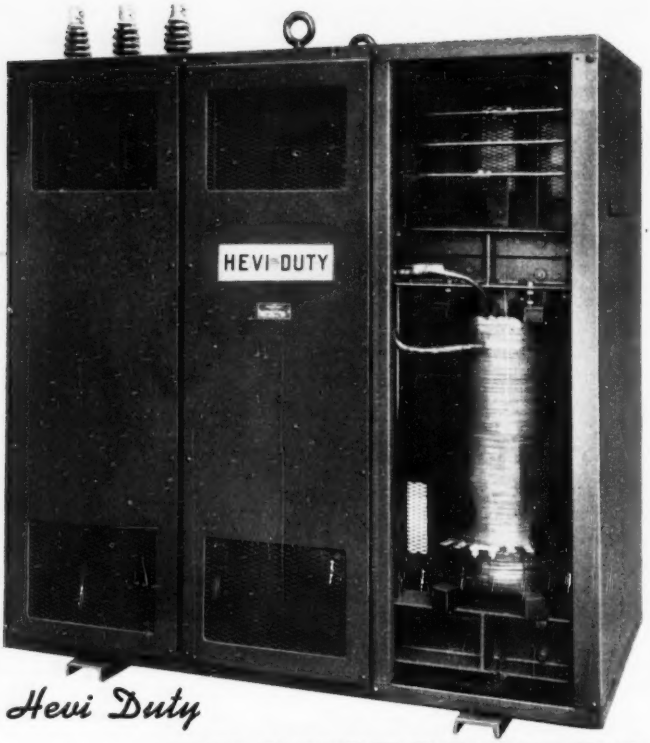
Suspension Insulators . . . Switch and Bus Insulators . . . Distribution Clamps Distribution Pin Types and Guy Strains . . . Transmission Line Fittings . . . Tree Insulators . . . Transformer and Circuit Breaker Bushings . . . One Piece and Multi-part High Voltage Pin Types . . . Suspension and Strain Clamps . . . Indoor Bus Support Porcelain . . . Lightning Arrester Porcelain.

PINCO INSULATORS



Hevi Duty

TYPE 31FH
500 KVA **TRANSFORMERS**

...for Power Distribution...give you *EXTRA* quality in every feature

With the increasing demand for transformers that can be installed at load centers, more and more engineers are looking to Hevi Duty to supply them with the finest and most efficient types.

Type 31FH shown above is illustrated with one panel removed to show the ease of access to the Bus Bar Secondary and Primary taps on the coil. You will note the end plate can be easily removed for installing secondary bus, or for attaching throat to secondary switch gear. This is a 500 KVA, 60 cycle transformer with 2400 volt primary and 240 volt secondary. Transformer is enclosed in a steel cabinet with ample air vents to insure proper cooling.

We have paid special attention to such details as providing proper electrical clearances, adequate coil blocking, clean coil and core ventilating ducts, and high insulation level. All coils are thoroughly impregnated with high corrosion and moisture-resistant varnish by means of vacuum pressure impregnation to give you extra quality and more years of service.

Write for complete details.

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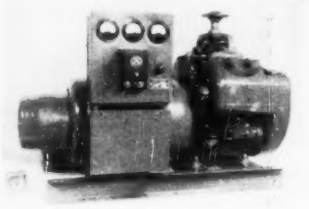
DRY TYPE TRANSFORMERS — CONSTANT CURRENT REGULATORS
MILWAUKEE 1, WISCONSIN

ratings from 0 to 20 in. of water column pressure or vacuum with range adjustment. They are available with double-throw circuits or floating contacts for use with reversing type damper control motors. Ratings of 10 amp at 125 v or 5 amp at 250 v a-c have UL approval.

•

Standby Power

Power plants suitable for standby power and emergency supply are manufactured by Kato Engineering Co, Mankato, Minn. These machines are powered by one, two and four-cylinder, air-cooled engines which have high tension magnetos for easy cranking. However, electrical starting may be specified.



Generators are available with or without voltage regulation; engines can be furnished with natural gas carburetors when desired. Illustrated is Model 49HAW4, 10-kw, 110/220-v, 60-c, 1800-rpm, revolving field generator, powered by a Wisconsin VP4, 29-hp, four-cylinder engine.

•

Classroom Luminaire

Furnished for two 40-w, with turret-type socket, four 40-w and two 85-w lamps, PSB series of fluorescent classroom luminaires are manufactured by The Spero Electric Corp, 18222 Lanken Ave, Cleveland 19, Ohio.

This series is available with perforated, luminous sides or with solid sides. The Spero "Travel-Hanger" is featured which allows stem placement anywhere along the entire length of the unit, in conjunction with "Easy-On" suspension. Luminaires are also adaptable for continuous row installation. All louvers hinge down for ease of maintenance.

•

Clamp-On Ammeter

With five current ranges up to 1,000 amp, and three voltage ranges up to 700 v, an a-c clamp-on ammeter and voltmeter, Model 633 Type VA-1, is announced by Weston Electrical In-

13 Reasons FOR USING HARPER NON-FERROUS and STAINLESS STEEL FASTENINGS

in your product in place of common steel

- 1 Resistance to Rust and Corrosion
- 2 Resistance to High Temperatures
- 3 Non-Magnetic
- 4 Non-Sparking
- 5 Re-Usable
- 6 Attractive Appearance
- 7 Easy to Clean
- 8 High Strength
- 9 Long Life
- 10 Lower Ultimate Cost
- 11 Resistance to Fatigue
- 12 Easy to Plate or Finish
- 13 Resistance to Abrasion and Wear

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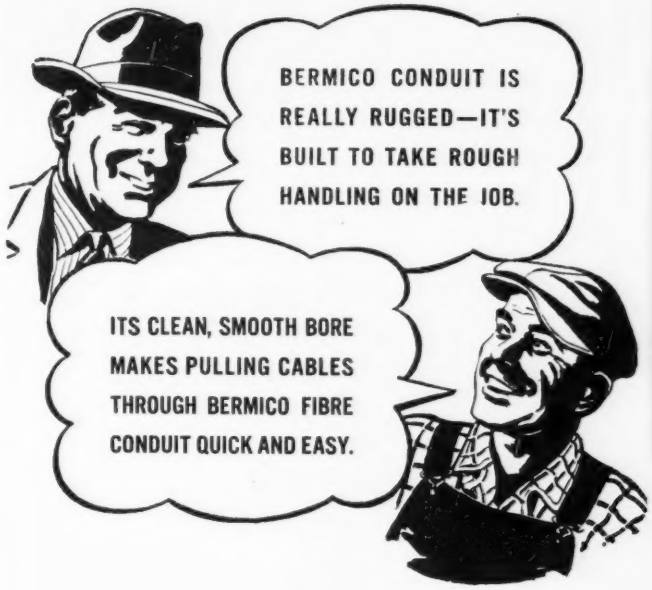
BERMICO CONDUIT IS REALLY RUGGED—IT'S BUILT TO TAKE ROUGH HANDLING ON THE JOB.
ITS CLEAN, SMOOTH BORE MAKES PULLING CABLES THROUGH BERMICO FIBRE CONDUIT QUICK AND EASY.

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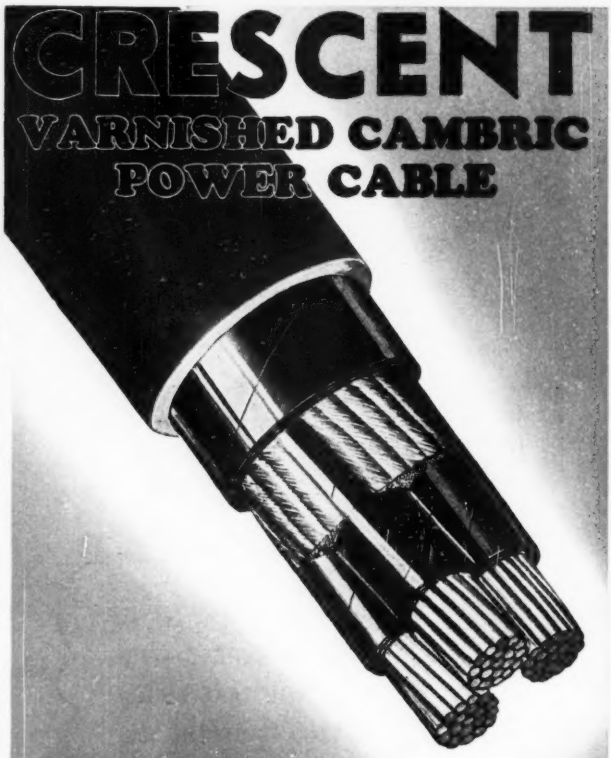
CRESCENT
VARNISHED CAMBRIC
POWER CABLE



Heavier loads for longer periods of time are possible with CRESCENT VARNISHED CAMBRIC CABLE. This general purpose, industrial power cable provides higher current-carrying capacity for the same size of copper conductors, together with maximum safety and permanence.

Available with weatherproof braid cover for dry locations, with a lead sheath for wet locations, or with a steel tape parkway armor construction (Type VCLJFJ) for burial in the earth without additional protection.

CRESCENT
WIRE & CABLE
OVER 60 YEARS EXPERIENCE
CRESCENT INSULATED WIRE & CABLE CO.
TRENTON, N. J.

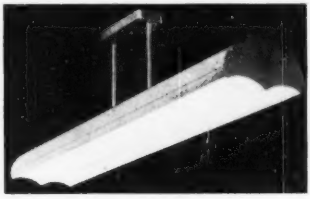
strument Corp. 617 Frelinghuysen Ave, Newark 5, N. J. Jaws will accommodate bare or insulated conductors up to 2 in. in diameter.

Voltage measurements are made by connecting 6-ft clip-on leads to the line and to screw-type recessed terminals in the side of the meter. Current and voltage readings can be taken almost simultaneously by rotating thumb-selector switch. The meter has an accuracy within 3% of full scale on all eight ranges.

•

School Fixture

A SEMI-DIRECT distribution-type luminaire for suspension mounting, the Solarlite Dean takes advantage of the 5-ft, 40-w low brightness lamp with



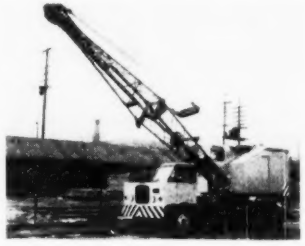
instant start. It is made by Solar Light Mfg Co, 1357 S. Jefferson St. Chicago, Ill.

Of all-metal construction, the Dean has reflecting surfaces finished in synthetic-baked-white-enamel and other surfaces of neutral-silvertone. Open bottom can be cleaned from the floor.

•

Truck Crane

TRUCK CRANE and carrier combination has been announced by The Northwest Engineering Co, 135 S. LaSalle St, Chicago, Ill. Crane has a capacity of 20 tons. Minimum boom length for



crane work is 30 ft, extendible to 100 ft by adding standard intermediate sections.

Outriggers extend full width of carrier and are reported to have unusual bearing support when extended. Rear

outrigger trunk is demountable and permits changing from crane work to shovel, dragline or push-shovel without repositioning lower base for crane.

•

Narrow-Beam Floodlight

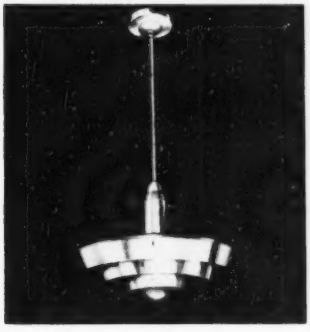
HAVING a specially designed narrow-beam reflector, a floodlight for illuminating long, narrow areas or spaces 150 ft away is made by General Electric Co's Lighting and Rectifier Divisions, Schenectady 5, N. Y. It is available from stock.

Beam angle is 20 deg vertical and 24 deg horizontal. Max beam candle-power is over 400,000. Front glass, resistant to heat, weather and impact, is spun-sealed to Alzak aluminum reflector. For aiming of the beam, a built-in rifle sight is included.

•

Indirect Luminaire

FOR USE with silver bowl lamps, an indirect luminaire, the Seelux, has been designed by The Edwin F. Guth Co, 2516 Washington Ave, St. Louis 3, Mo. Louvers are spun aluminum with emery-



grained finish and are protected with Alzak aluminum process.

Silver bowl lamp contains the major reflector. Open louvers are said to eliminate critical maintenance problems encountered with indirect lighting fixtures.

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POWER SERVICE . . .

an obligation to industry

Uninterrupted service is a cardinal principle in the furnishing of electrical power, an item of essential importance to the user. A transformer fire means more than the loss of electrical equipment and structures. Production losses from out-of-service time are non-replaceable.

Both utility companies and private users have for years been installing fire protection for key facilities. Through the relatively recent development of *Automatic* FIRE-FOG, the safe use of water for the extinguishment of electrical equipment fires, protection of large and small indoor and outdoor electrical installations is now practical from an economic point of view.

Automatic FIRE-FOG is specifically designed for your particular risk . . . electrically safe . . . approved by all leading insurance authorities.

We'll be glad to furnish engineering counsel on *Automatic* FIRE-FOG for your operations upon request . . . *no cost or obligation of course.*

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. . . a famous member of the *"Automatic" Sprinkler* Family . . . provides basic fire protection for process equipment and storage in the chemical and petroleum industries. On-the-spot protection for quench tanks, dryers, explosive hazards, conveyor openings, air filters, oil filled electrical equipment and other units vital to production line operations.

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FIRST IN FIRE PROTECTION

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Westinghouse

Here's Better Protection for Low-Voltage Circuits

The NEW "DB"

It's a completely new breaker, designed for severe, continuous duty as the protective link between the power source and your productive equipment. Its many features are all planned to provide minimum maintenance throughout a long operating life:

New Overcurrent Tripping Device—Hermetically-sealed overcurrent trip provides time-delay on overloads, plus instantaneous tripping on fault currents. Short time-delay characteristics on fault currents for selective tripping when specified.

All-Metal Mounting Base—Provides a strong, rigid foundation for all parts.

Unit Construction—All attachments and parts easily removed as a unit.

"De-ion" Arc Interruption—For quick arc extinction . . . longer contact life.

Easier Installation—Smaller size . . . easier to work around. Free standing when unmounted.

Long Operating Life—Moving and wearing parts of hardened stainless steel. J-60719

Here's COMPLETE Information

Get answers to your questions, plus complete, detailed information from the new DB Breaker Book. Ask your Westinghouse representative or distributor for your copy of B-4067, or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa

Westinghouse

"DE-ION" CIRCUIT BREAKERS

New Type DB

NEWS ABOUT PEOPLE

New Orleans Utility Elects Three Vice-Presidents

Three executives of New Orleans Public Service, Inc, have been elected vice-presidents. Those promoted include Streuby L. Drumm, general sales manager; Walter J. Amoss, director of advertising and George S. Dinwiddie, economist.

STREUBY L. DRUMM

Mr Drumm has been general sales manager since 1940. He became identified with the New Orleans utility in 1925 as a commercial salesman. Subsequently he served as assistant rate engineer, residential sales manager, industrial and commercial sales manager, and then general sales manager.

WALTER J. AMOSS

Mr Amoss has been associated with the company since 1931, when he was employed as an engineer in the industrial and commercial service department. Subsequently he was appointed general sales manager and then assistant to the vice-president in charge of operations. Later he was made director of advertising.

GEORGE S. DINWIDDIE

Mr Dinwiddie was first employed by the company in 1936 as a tax and research clerk. Later he became budget director and executive office assistant and more recently head of the budget and statistical department.

•

Philip D. Reed, chairman of the board of the General Electric Co, was recently elected president of the International Chamber of Commerce.

B. E. Harris has been elected a vice-president of Ford, Bacon & Davis, engineers-constructors. Mr Harris has been with the organization since 1923, having had charge of many large projects in the fields of design, construction, valuations, and reports. During World War II he was general manager of the Arkansas Ordnance Plant in Jacksonville.

H. D. Anderson, vice-president and secretary of the American Gas & Electric Co, New York, and a vice-president of most of its subsidiary companies, asked to be retired from active duty on July 1 after more than 40 years' service. His services will be retained until early 1952, his normal retirement date, in an advisory and consulting capacity. For the present he will continue as a member of the board of directors of American Gas & Electric.

E. H. Dixon Made President of Middle South Utilities

Edgar H. Dixon has been made president of Middle South Utilities, Inc, recently formed following the reorganization of the Electric Power & Light Corp. Mr Dixon has been president of Electric Power & Light Corp since 1944.

EDGAR H. DIXON

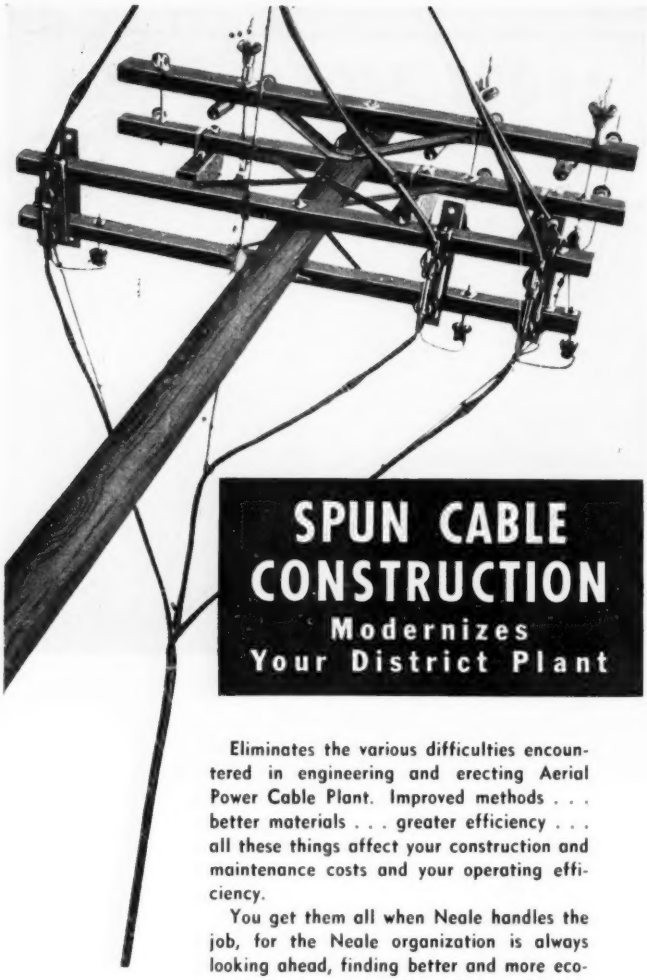
Prior to his election as EP&L president, Mr Dixon had served as secretary and treasurer and then as executive vice-president of the company.

Middle South Utilities will acquire the common stock of the four companies comprising the closely integrated ALMNO system, Arkansas Power & Light, Louisiana Power & Light, Mississippi Power & Light, and New Orleans Public Service.

•

Lawrence Palmer, associate engineer for the Puget Sound Power & Light Co at Seattle, Wash., has been promoted to engineer, replacing **Carl Myers,** who has joined Ebasco Services, Inc in New York.

William Van C. Brandt, one of the pioneers in the battery-powered industrial truck industry, has been appointed managing director of the Electric Industrial Truck Association, North Broad St, Philadelphia 40, Pa. Active in the EITA for the past 25 years, Mr Brandt has resigned as manager of railway and motive power sales for the



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Modernizes Your District Plant

Eliminates the various difficulties encountered in engineering and erecting Aerial Power Cable Plant. Improved methods . . . better materials . . . greater efficiency . . . all these things affect your construction and maintenance costs and your operating efficiency.

You get them all when Neale handles the job, for the Neale organization is always looking ahead, finding better and more economical ways to produce the results you want.

Typical of this constant striving for improvement is the Neale Model "K" Cable Spinner, created and perfected as a practical solution to the varied problems that arise in connection with power line construction and maintenance.

Spun Cable Construction Services Coast to Coast!

The Neale organization is made up of practical, experienced men working with the most modern and efficient equipment available. Let them help you on your next erection or maintenance job.

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ENGINEERING • CONSTRUCTION • MAINTENANCE
TOPEKA, KANSAS PHONE 4-2621

Electric Storage Battery Co of Philadelphia to accept the new position. He succeeds **Charles F. Kells,** who resigned to become eastern manager of the B. J. Martin Publishing Co, Chicago. Succeeding Mr Brandt as vice-president of EITA is M. W. Heinritz, vice-president of Gould Storage Battery Corp. Trenton, N. J.

•

Schacht Made General Manager, Consumers PPD

R. L. Schacht, formerly general superintendent and acting general manager, Consumers Public Power District,

R. L. SCHACHT

Columbus, Neb., has been appointed general manager to succeed the late V. M. Johnson.

Mr Schacht has a background of 26 years of continuous utility operation and engineering in Nebraska. He began his utility career as an accountant-engineer with the Continental Gas & Electric Corp, predecessor of the Iowa-Nebraska Light & Power Co, in Omaha in 1923. Serving in various capacities with the company and its successor organizations, he was transferred to Lincoln in 1925 when the company's general offices were moved there.

He was appointed eastern division superintendent of Consumers PPD in 1941, when the Iowa-Nebraska Co properties were purchased. He was named superintendent of transmission and distribution of the system in 1944 and was appointed general superintendent and moved to the general office in Columbus in 1947. He continued to hold this position while serving as acting general manager during Mr Johnson's illness.

•

Harold Nay, formerly associated with the Wichita division of the Kansas Gas & Electric Co, has been transferred to the general office to become industrial sales manager. This position has been

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WHILE ENERGIZED
. . . . Lowers Maintenance Costs
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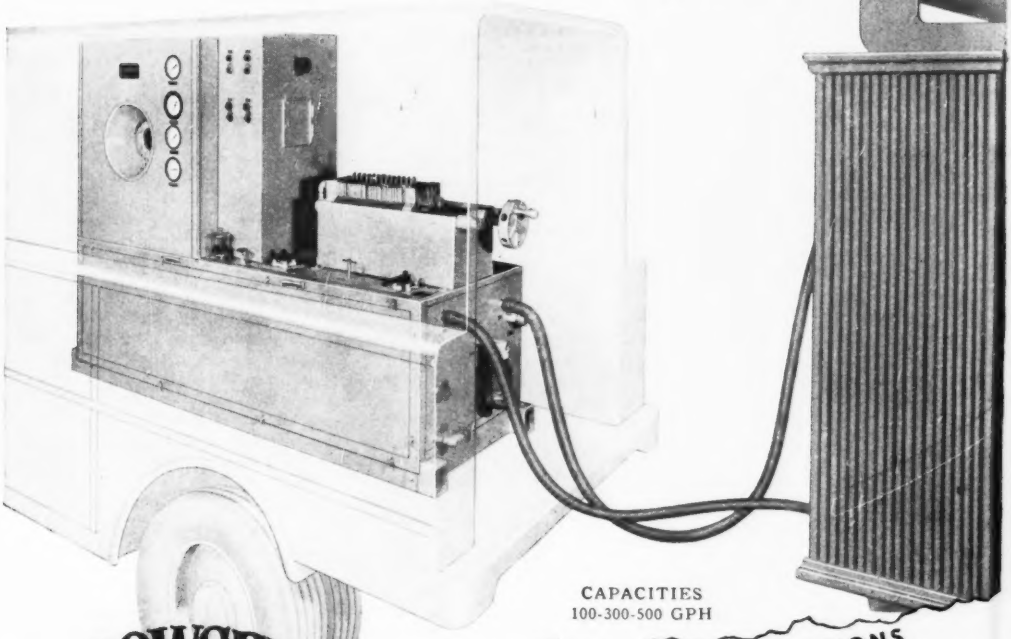

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ESTABLISHED 1885
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. . . an exclusive Bowser process, restores oil dielectric to 35 k.v. *in a single pass!* It removes volatile corrosive acids, gases and dissolved moisture which promote sludge formation in insulating oils.

Hydro-Volified oil surpasses its original insulating values and has greater stability. These features—and many others—add up to new operational economies and efficiencies that you'll surely want to investigate.

Write today for your copy of the Hydro-Volifier Bulletin. It gives you case histories and a complete description of the process.

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One man and a truck-mounted Hydro-Volifier efficiently serve widespread substation systems.

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No tank trucks required for removal of contaminated oil and refilling with clean oil. Transformers and circuit breakers remain in full service while insulating oil is reconditioned—fewer spare units are needed.

C—Cuts Overhauling Costs
Transformers and circuit breakers retain high efficiencies indefinitely—overhaul periods few and far between.

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GUY STRAIN INSULATORS

Manufactured under rigid control standards, from the careful selection of materials through all steps leading to the top quality finished product. Internal stress eliminated through uniform firing at constant temperatures.

Available from large stocks of standard sizes.

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SPOOL INSULATORS

You won't find a better wet process porcelain spool! Here's the right combination of dependable mechanical and electrical strength in a wide range of styles and sizes produced to the usual high quality standards maintained by Illinois. Also manufactured by the dry process method to your specifications.

HIGH DIELECTRIC STRENGTH
HIGH MECHANICAL STRENGTH
EXACT DIMENSIONS
COMPLETE UNIFORMITY

®

ILLINOIS
ELECTRIC PORCELAIN CO.

•

MACOMB, ILLINOIS

•

reinstated because of the increase in the importance of the company's industrial power business, coupled with plans for stepping up its industrial promotional activity. Mr Nay has been identified with Kansas Gas since 1925.

•

Allen N. Cartwright Retires As West Penn Power V-P

Allen N. Cartwright has retired as vice-president of the West Penn Power Co after completing nearly 46 years of service.

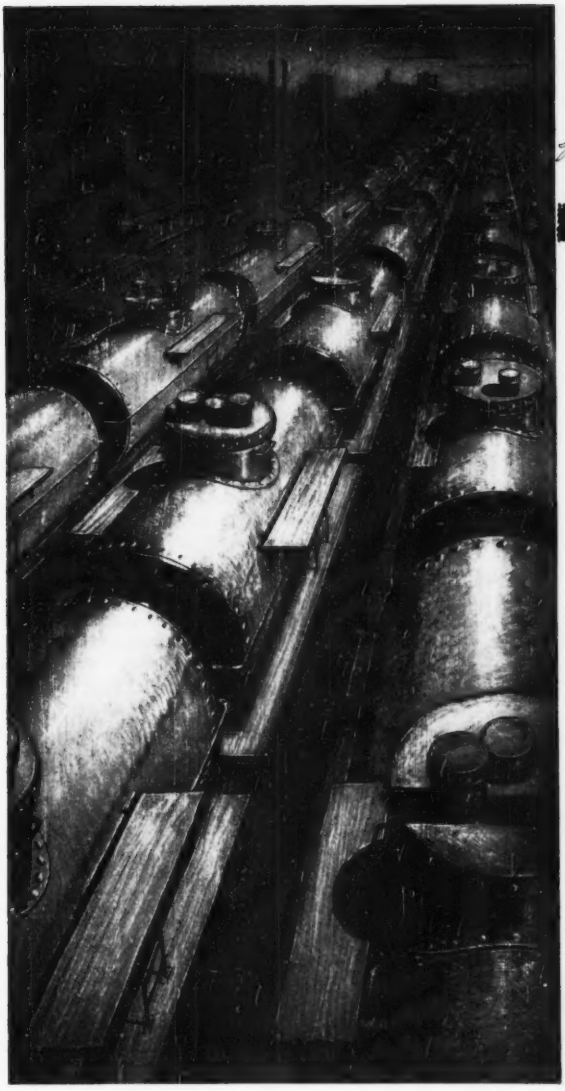
Mr Cartwright is one of the outstanding figures in the technical end of the electric utility business. Starting with West Penn at Connellsville in 1903, Mr Cartwright became foreman on construction and operation of substations the following year and three years later was placed in charge of all electrical construction of substations and power stations. In 1911 he was made superintendent of operation of power stations and substations. This position he held for 18 years. His headquarters were transferred in 1915 from Connellsville to Pittsburgh. Appointment as general superintendent of the power division preceded by 10 months his election to the vice-presidency in 1930. In this capacity, Mr Cartwright was responsible for all construction, operation, and maintenance of the physical property used in the operation of the company's business.

•

Frederic A. Lazenby has been appointed head of a new hydraulic department set up by the British Columbia Electric Co at Vancouver, B. C., to study and design future company hydroelectric developments. Mr Lazenby has been assistant superintendent of generating stations for the B. C. Electric Railway Co since 1940. Besides carrying out of design and supervision of future hydro construction, the new department will provide a consulting service on hydraulic matters to the electrical division. Mr Lazenby first joined the company's construction department in 1925 and remained until 1932. After an absence of four years, he returned to the company.

W. F. Ficklen, vice-president of the Appalachian Electric Power Co, with headquarters in Charleston, W. Va., has retired. Mr Ficklen will continue to be available to the company in a consulting capacity. Mr Ficklen has been associated with Appalachian for more than 30 years. He was made division manager 22 years ago and vice-president in 1943. He has supervised and

All from the same batch



All the U·S·S Creosote Oil in these cars . . . in fact, *all* U·S·S Creosote Oil . . . is from the same batch. That's because batching is a continuous operation at the world's largest tar distillation plant, where U·S·S Creosote Oil is produced.

The result is a completely uniform product . . . and a uniformly *good* product. You know exactly what you are getting, and you can predict accurately the results of its use.

For example, you can count on years of extra service from poles that have been treated with U·S·S Creosote Oil. You can count on complete protection against dry rot, fungus, termites and other wood destroyers. You can count on lower yearly pole replacement costs.

U·S·S Creosote Oil is *proved* protection for your property. For more than 20 years, the nation's leading utilities, railroads, contractors and wood treaters have taken advantage of this method of preservation.

Whether you need a tank-car load or a full barge, we offer prompt delivery. Meanwhile, if you have any questions concerning Creosote Oil and what it can do for you, feel free to consult us. There's no obligation.

COAL CHEMICAL SALES DIVISION
United States Steel Corporation Subsidiaries
71 Broadway, New York 6, N. Y.

CREOSOTE OIL

UNITED STATES STEEL

To Help Good Workmen Make
Permanent Connections

These Sherman Splicing Sleeves give your workmen the finest of material with which to make strong, permanent, corrosion-free joints of highest conductivity.

A highly dependable line of sleeves, widely used throughout the electric utility trade. Each sleeve stamped for easy identification. Carefully packed.

Write for catalog illustrating the full line of Sherman Electrical Specialties and giving complete specifications.

H. B. Sherman Mfg. Co.
Battle Creek, Mich.

Sherman
SPLICING SLEEVES

directed expansion of the company's facilities in the Charleston area. Mr Ficklen began his career in the electric utility business in Vermont and went South in 1912.

•

Electrical Industry Men Honored by Universities

Among those who received honorary degrees at the recent commencement exercises of various universities were several representatives of the electrical industry.

Frederic A. Schaff, chairman of the board of Combustion Engineering-Superheater, Inc, New York, was honored by his Alma Mater, Purdue University, with the degree of doctor of engineering in recognition of "contributions to the design and production of equipment harnessing power for the benefit of mankind."

John Van Brunt, vice-president, Combustion Engineering Co, for more than a quarter of a century and since last January engineering consultant for Combustion Engineering-Superheater, Inc, received the degree of doctor of engineering from Stevens Institute of Technology.

James J. Nance, president of Hotpoint, Inc, received the degree of doctor of laws at Lawrence College, Appleton, Wis.

Don G. Mitchell, president, Sylvania Electric Products, Inc, was awarded the degree of doctor of laws from Parsons College.

Stanley M. Hanley, partner in Power Equipment Co, Detroit, was award a doctor of science degree by Wittenberg College, Springfield, Ohio, in recognition of his outstanding achievements in developing communications equipment for use by the Signal Corps and the U. S. Navy during the war.

Thomas D. Jolly, vice-president in charge of engineering and purchases for Aluminum Co of America, received the degree of doctor of engineering from Rensselaer Polytechnic Institute.

James P. Growdon, Alcoa's chief hydraulic engineer, was also awarded a doctor of engineering degree by the University of Nebraska.

Henry M. Brundage, manager of the automatic heating division of General Electric Co's air conditioning department, Bloomfield, N. J., was awarded the degree of mechanical engineer by Stevens Institute of Technology for his contribution to the field of public service.

Elmer W. Engstrom, vice-president in charge of research for the Radio Corp of America, was awarded the degree of doctor of science by New York University.

OBITUARY

Ernest B. Black, senior partner in the Black & Veatch Engineering Co, Kansas City, Mo., died on July 4 as the result of a heart attack. He was 67 years old. Mr Black served as a consulting engineer on War Department projects during both World Wars. He was a past-president of the American Society of Civil Engineers.

Walter C. Pearce, director of street-lighting sales for the Central New York Power Corp, Syracuse, at the time of his retirement in 1940, died on June 21 after an illness of two years. He was 75 years old.

J. L. Wright, superintendent of the meter department of the Toledo (O.) Edison Co from 1918 until his retirement in 1947, died on July 5.

Graham Davies, retired purchasing agent for the Louisville, Ky., Gas & Electric Co for many years, died in that city on June 13. Mr Davies became purchasing agent for the old Louisville Lighting Co in 1912, continuing in that capacity when the utility merged into Louisville Gas & Electric the following year. He retired several years ago.

John H. Kurlander, head of the projection, photographic, and miniature lamp section of the commercial engineering department at the Westinghouse Lamp Division in Bloomfield, N. J., died of a heart attack at his home in Nutley, N. J., on June 24. Born in Trenton, N. J., Mr Kurlander became associated with the Westinghouse Lamp Division in 1929. He had previously been identified with the Edison Lamp Works in Harrison and with the Brenkert Light Projection Co in Detroit.

Dr Carl D. Thompson, widely known authority on public ownership of public utilities, died in Lincoln, Neb., on July 3 at the age of 79. Dr Thompson organized the Public Ownership League of America 35 years ago. He campaigned for public ownership of power companies and wrote books and pamphlets on this subject. Mr Thompson was a consultant for the Bonneville Power Administration from 1938 to 1947.

ORANGEBURG
FIBRE CONDUIT

STANDARD
Installed with Concrete

NOCRETE
Installed without Concrete

On Guard Over 50 Years
UNDERGROUND

During the past 50 years—an era of great expansion for the Electrical Industry—ORANGEBURG CONDUIT has provided constant 4-way protection for the vital cables through which UTILITY COMPANIES supply the *life fluid* of modern illumination, heat and power for modern homes, offices, factories and farms. ORANGEBURG CONDUIT protects cables from . . . (1) *Cable Sheath Abrasion* . . . (2) *Pulling Tensions* . . . (3) *Corrosion* . . . (4) *Wear on Sheath* from *Cable Movement* with changing loads.

This record of 50 years underground pays tribute to the uniquely tough, strong, resistant materials of which ORANGEBURG CONDUIT is made . . . and their capacity to withstand corrosive ground waters and chemical wastes *permanently*.

Also important to UTILITY COMPANIES is the fact that ORANGEBURG CONDUIT is easy to handle, transport, install . . . low in initial and maintenance costs.

For more complete information write today for ORANGEBURG Catalog No. 50. Keep it for ready reference in your files.

ORANGEBURG STANDARD—For installation with concrete encasement.

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General Electric Supply Corp.

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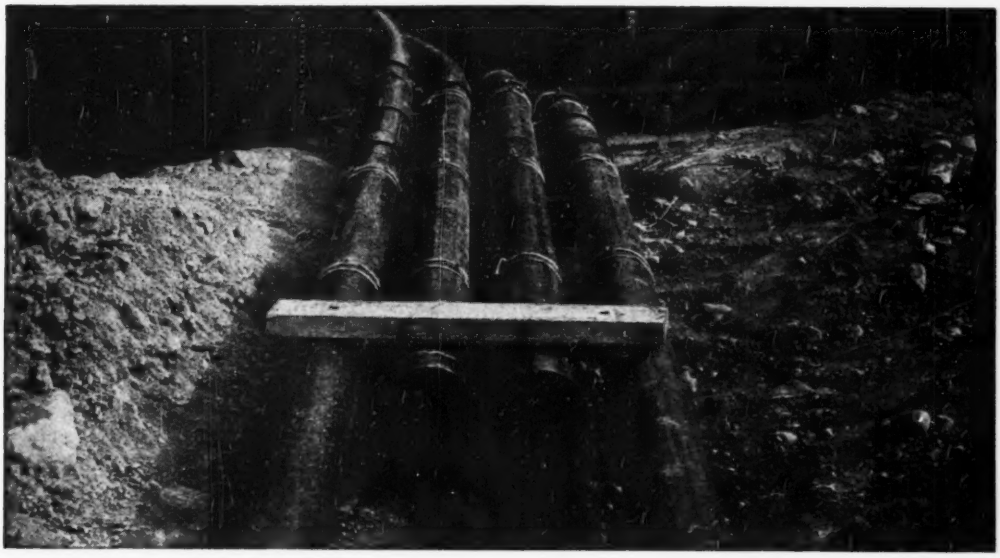


MANUFACTURERS and MARKETS

SALES PERSONNEL from all sections of the country were assembled by the Southern States Equipment Corp, Hampton, Ga., for the first general sales meeting ever held by the company. Shown inspecting new equipment in the company's plant are, left to right, Ed Waterman, St. Louis; Harold Sines, Engineered Sales, Inc, Chicago; Tom Burdeshaw, sales manager; C. W. Lint, Engineered Sales, Chicago; E. C. Carlson and Fred Klass, Minneapolis; T. K. Pollock, F. W. Pollock Co, Jackson, Mich.; J. F. Shouse, Louisville, Ky., and Tom Curtis, chief engineer. The two-day conference featured new equipment

B. C. Electric Lets Contract for Third 47,000 hp Unit

Contract has been awarded by the B. C. Electric Co at Vancouver, B. C., for the third 47,000-hp unit to be installed at the Ruskin plant of the company, Thomas Ingledow, vice-president and chief engineer of the company, has announced.

Total cost of the project, which is scheduled for completion by October, 1950, will be $2 million. This will bring the overall investment at Ruskin to more than $11 million since the station was first opened in 1930.

Northern Construction Co and J. W. Stewart Limited won the general construction contract with a bid of $750,000, Mr Ingledow reported, and work gangs from those companies are now on the site.

Dominion Engineering Co of Montreal will build and install the turbine for $440,000. Canadian Westinghouse, which supplied the first two generators, will build and install the third one for $640,000.

Canadian General Electric will furnish two of the three transformers required for $70,000. The third, the chief engineer said, is already on hand. He added that contracts for the 24-ft steel penstock, switching and control equipment, and other essential parts of the new unit would be awarded in the near future.

•

"Cobra" Pole Process to Be Introduced into America

(McGraw-Hill World News)

Soon to be introduced in America is the "Cobra" process for injecting wood-preservatives into standing poles for prolonging their service life. The method has been in extensive use in Europe since 1933, but is only now being brought into the United States.

An American company, the Wood Pole Reimpregnation Co, Suite 602, 559 Fifth Ave, New York (temporary address), has been formed to provide a contract service to electric utilities and other pole-line users.

The wood-preservative used in the "Cobra" process consists of sodium fluoride, dinitrophenol, and arsenious anhydride, to which various cohesives are added. It is injected directly into the fibres of the standing pole by the equivalent of a large hypodermic needle. One man can operate the injection equipment, which plunges a large flat hollow needle into the pole to a depth of 2¼ to 2½ in.

The method is reported to have prolonged the lives of poles on which it has been used by an average of 15 years, with a minimum of 12 years and in some cases as much as 20 years.

MANUFACTURING BRIEFS

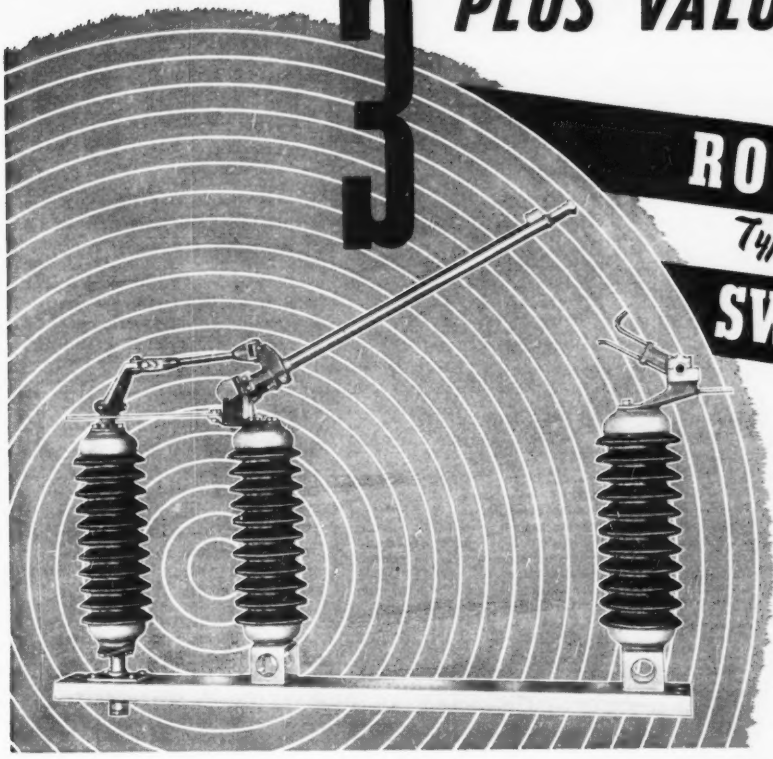
Workers passed up the possibility of a wage increase recently when the 3,554 AFL members at the Babcock & Wilcox plant at Barberton, Ohio, decided no wage increase is warranted "at this time." They signed a new, two-year contract with the company which grants concessions, however, and allows the wage issue to be reopened in a year. Gains, according to the union, include a "restricted" compulsory arbitration clause, six paid holidays, and several minor improvements in working conditions.

First shipments of aluminum electrical conductor cable were made last week by the Permanente Metals Corp from its new aluminum rod, bar, and cable mill at Newark, Ohio. Deliveries are starting more than three months ahead of the schedule set by Permanente when it began last year to install the equipment for the production of wire and cable in the plant.

Bids for seven 56,500-kva transformers for McNary Dam on the Columbia River between the states of Washington and Oregon have been called by Col William Whipple, U. S. District Engineer, for opening Aug 2 at Walla

3 PLUS VALUES OF

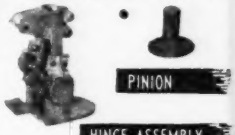
ROYAL Type VVL SWITCHES



*1 SIMPLICITY OF DESIGN

2 HIGH PRESSURE POINT CONTACTS

3 SEALED BALL BEARINGS



Only SIX SUB ASSEMBLIES

* 1. Simplicity of Design

Because simplicity makes for operating dependability, Royal engineers have made the type VVL switch extremely simple, easy to operate, and easy to maintain. The only blade movement is a simple direct lift, which eliminates supplementary blade movement and the necessary actuating mechanism. Braid shunts were thereby eliminated — 12 years ago, by this company. In this way the number of parts above the insulator on each pole has been reduced to only 18, and we are still seeking further simplification. Altogether there are only six sub-assemblies. High pressure point contact is obtained by expanding the contact rods across the long axis of the blade's contact cam and the hinge contact. Blades are counterbalanced from 46 KV up. There are only four bolted connections in the switch, all silver-plated. This is a well-engineered, serviceable switch. Ratings from 7.5 to 161 KV and 400,600 and 1200 Amperes.

To see the full line of switches, power connectors, clamps, fittings and construction accessories, write for your copy of Royal's 220-page Catalog No. 11.

35 YEARS
A Part of the Arsenal of
AMERICAN POWER PRODUCTION

Royal ELECTRIC MANUFACTURING COMPANY INCORPORATED
1122 EAST 87th STREET Chicago 19, Ill.
Designers and Manufacturers of Power Switching Equipment and Special Electrical Devices

no question about this tension—
It'll be exactly right, come high winds . . . heat or cold . . . Because it's being checked with a Dillon Dynamometer . . . Checked to maintain correct tension for stability and support in guy wires—for adherence to the tension recommended by the manufacturer. Accurate guying this easy way really pays off.
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DYNAMOMETERS

The Dillon Dynamometer is easy to use, portable, light weight. Precise, sensitive, yet extremely rugged — the Dillon Dynamometer can not be injured by overload — shackles are drop-forged to a strength of double the capacity. Can be worked with a rope block, chain hoist or truck winch. WRITE TODAY FOR YOUR FREE COPY OF BULLETIN AND "RULES FOR SUCCESSFUL WIRE PRE-STRETCHING AND STRINGING."

W. C. DILLON & CO., INC.

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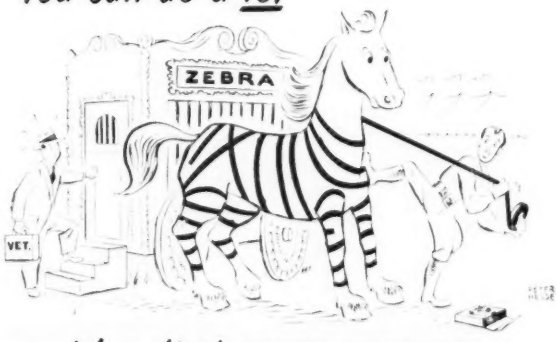
You can do a lot



with a little **GOLD SEAL TAPE**

There's more tape value in every roll because there's no waste. Gold Seal Tape *goes further*. And, rain or shine, you can depend on it to stick to the job . . . speed the work. Try Gold Seal Tape next time. In single rolls and handy 10-roll containers. Jenkins Bros. (Rubber Division), 80 White St., New York 13.

JENKINS Gold Seal Tapes FRICTION...RUBBER

MADE BY JENKINS BROS. . . . MAKERS OF FAMOUS JENKINS VALVES

Walla, Wash. Delivery of the first three transformers for generators No. 1 and No. 2 is set for July 1, 1953, with the other four to be delivered by Nov. 15, 1953. Bids for two 3,750 kva a-c generators for the McNary power plant will be opened July 29, with delivery of the first set for Jan 1, 1953, and the second for Feb 15, 1953.

McGraw Electric Co has filed action under the Feld Crawford Act for violation of Fair Trade Agreements in effect in New York State, establishing minimum retail prices on Toastmaster toasters, against Marks Appliance Co, 143 Greenwich St. and Oscars, Inc., 176 Greenwich St. both of New York City.

A show cause order for July 18 was signed last week by Federal Judge Guy L. Fake in Newark, N. J., for creditors and stockholders of Solar Manufacturing Corp as to why assets of the corporation should not be sold to Sprague Electric Co, North Adams, Mass., for $525,000. The order, requested by George Furst and John J. McGirl, reorganization trustees, provides for acceptance of any better offer.

Electric Industrial Truck Association has moved its executive offices to the Beury Bldg, 3701 North Broad St, Philadelphia 40, Pa. The association formerly occupied offices at 29-28 41st Ave, Long Island City 1, N. Y.

A new company, Electro-Temp, Inc, Ann Arbor, Mich., has been organized by Blair H. Chamberlin and Marvin W. Craine to manufacture special and standard heating elements for electric ranges. The factory is located at Dexter, Mich. Both Mr Chamberlin and Mr Craine were previously associated with H. W. Tuttle & Co, Adrian, Mich.

Wagner Electric Corp, St. Louis, has introduced a new publication entitled "Wagner Industrial Product News", which the company is mailing to industrial companies on a bi-monthly basis. Objective is to circulate news of the company's electrical products. Copies may be obtained by writing to Editor, W.I.P. News, Wagner Electric Corp, 6491 Plymouth Ave, St. Louis 14, Mo.

•

GE Farm Welding Booklet

A new 24-page booklet, "87 Welding Ideas for the Modern Farmer," which features specific case histories on how farmers from practically every state have used their GE farm welders to repair, remodel, and completely fabricate farm equipment, has been an-

nounced as available from the General Electric Co, Schenectady 5, N. Y. Listed as publication GEA-5053, this two-color, pocket-sized booklet contains 87 illustrated case histories, a section on basic welding techniques, and a page on selection of electrodes for any particular job.

•

Manufacturers Make New Sales Assignments

Electrical manufacturing companies have recently made the following appointments to their sales staffs:

Combustion Engineering-Superheater, Inc. has appointed H. D. Nickle manager of the new district office for the Northwest territory, including the states of Washington and Oregon, with headquarters in the Skinner Bldg, Seattle. Walter Springe, for many years district manager, Kansas City, has been made division manager, with headquarters in Kansas City, Mo., and C. J. Grossi district manager, Tulsa, Okla. T. E. McMahon has been transferred from the Philadelphia district office to the Kansas City office as district manager and W. J. Woodruff has been made district manager of the St. Louis, Mo., office.

Hubbard & Co. Pittsburgh, Pa., has transferred William J. Meinert to the sales force covering the Ohio and southeastern Michigan territory, which until recently was served by Leonard P. Schafer. Mr. Meinert has been associated with Hubbard for 25 years.

Allen Bradley Co. Milwaukee, has appointed the Young Electric Manufacturing & Supply Co, 2134 Curtis St, Denver 2, Colo., Denver representative.

Oliver Iron & Steel Corp. Pittsburgh, has appointed Paul T. Persons Carolinas' district representative for the pole line materials division. Mr. Persons will make his headquarters in Charlotte, N. C., and will service the states of North and South Carolina and eastern Tennessee.

Electromaster Inc. Mount Clemens, Mich., has appointed six special sales representatives for the Eastern, Mid-West, South and West Coast areas. D. L. Kirk will cover Indiana, Kentucky, western Ohio, Michigan, Illinois, Wisconsin, and southeastern Missouri; E. G. Kramer, Minnesota, North Dakota, South Dakota, Wisconsin, Iowa, Nebraska, Kansas, Missouri, and Oklahoma; E. R. Sigler, western Pennsylvania, northeastern Ohio, northern New York, and northern West Virginia; F. C. Stevenson, California, Washington, Oregon, Idaho, Nevada, Montana, Utah, Wyoming, Colorado, New Mexico, and Arizona; V. L. Kilby, North and South Carolina, Georgia, Florida, Tennessee, Alabama, Mississippi, Louisiana, Arkansas, and Texas; A. W. Roberts, New England, eastern Pennsylvania, Maryland, West Virginia, Virginia, New Jersey, and southern New York.

Sylvania Electric Products, Inc. has appointed R. B. Fogarty Atlanta (Ga.) division manager to succeed Hugh Saussy, resigned. Mr Fogarty was formerly assistant division manager.

CASE HISTORY
confirms 30-year service life for treated poles

...AND CREOSOTE GETS THE CREDIT!

HERE's a convincing case history* concerning 71 pressure-creosoted pine poles—part of an electric power transmission line erected in Kansas in 1917.

In 1947, after 30 years in line, 68 out of 71 poles were still sound and serviceable—furthermore, the inspection revealed that these poles appeared to be capable of service for some time to come. Of the remaining 3 poles, 2 had been removed because of line changes—1 had been damaged by lightning.

Of the original 71 poles, *not a single one had been removed because of decay*—a splendid testimonial to creosote. And all the more noteworthy when you consider that the preservative treatment used to protect these poles was somewhat lighter than is now regarded as good practice.

Creosote is the performance-proved, time-tested preservative for poles and crossarms. And for the best possible creosote delivery service, get in touch with the nation's largest distributor—Koppers. With 14 creosote-producing plants—with 4 large storage plants—Koppers can always meet your creosote requirements.

KOPPERS COMPANY, INC.
Pittsburgh 19, Pa.

*Wood Preserving News—1947

All Standard Specifications
For All Types of Wood Preservation

KOPPERS CREOSOTE...to be sure!

AM, FM, and TV

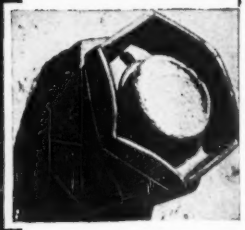
TOWER BOLTS STAY TIGHT

when locked with

PALNUT

TRADEMARK

SELF-LOCKING NUTS



1. Prevent loosening of regular nut and bolt.
2. Eliminate checking and retightening of bolts.

TRYLON LADDER TOWERS, manufactured by Wind Turbine Co., West Chester, Pa., have used PALNUTS since 1933, with complete satisfaction.

The simple application of PALNUTS on top of regular nuts, is absolute insurance against future loosening or maintenance of the bolted assemblies in your towers. PALNUTS exert a powerful double-locking action which defies vibration. They hold assemblies to original tightness. Low in cost, easily applied, may be removed and re-used. For years, standard equipment on Signal Corps, radio and transmission towers. Available in a wide range of sizes. Hot Dip Galvanized for weather resistance. Specify PALNUTS for your towers. Send details of your needs for samples. Ask for PALNUT literature showing full line for many radio applications.

The PALNUT Co.

51 CORDIER ST., IRVINGTON 11, N. J.

NEW ELECTRICAL CONSTRUCTION

NEW ELECTRICAL construction projects announced by private and government utility systems involving more than $70,000. Also listed are major industrial and construction jobs where electrical work is included

UTILITIES

Proposed Construction

Arizona and Nevada—Bureau Reclamation Dpt. Interior, Bldg. 1-A, Denver Federal Center, Denver, Colo., sixty-two 15,000 volt disconnecting switches for Coolidge substation Davis Dam Proj., Spec. 2721. L. N. McClellan, ch. engr.

Georgia — Okefenoke Rural Electric Membership Corp., Nahunta, 311 mi. rural distr. lines and sys. imprvs., Brantley Co., **$730,000.**

Ill., Lincoln—State Welfare Dpt., Springfield, general work, heating, ventilating, plumbing and underground electrical distr. sys. power plant, Lincoln State School and Colony, $2,000,000. C. Herrick Hammon, State Armory, Springfield, state archt.

Iowa—Central Iowa Power Co-operative, Cedar Rapids, 30 mi. 115 kv. lines, 129 mi. kv. transmission lines, addnl. power unit, 1 substation, etc., Linn Co. **$4,065,000.** Brown Eng. Co. K. P. Bldg., Des Moines, engr.

Ia., Milford—City, City Hall, power plant imprvs., incl. plant addn., generating unit, conversion diesel engine, switchboard, $70,000. Buell & Winter, 508 Insurance Exchange Bldg., Sioux City, engrs.

Kentucky—Warren Rural Electric Cooperative Corp., Bowling Green, 450 mi. rural distr. lines, sys. imprvs., Warren Co., **$1,345,000.**

La., Lake Charles—Gulf States Utilities Co., Beaumont, Tex., 40,000 kw. electric generating unit, **$1,750,000.**

Minn. Elk River—Long & Thorshov, archts., 400 Metropolitan Life Bldg., Minneapolis, sub-structure power bldg., 11,500 kw. power plant, for Rural Electric Cooperative Power Assn., Maple Lake, $70,000. R. D. Thomas & Assoc., 400 Metropolitan Life Bldg., engrs.

Minn., Fairibault—HOSPITAL—State, Dept. Admin., 19 State Capitol, St. Paul, plans by G. Shifflet, Barkstrom & Assoc., 17 W. Lake St., Minneapolis, hospital addn., power plant, State School for Feeble Minded. **$1,750,000.**

Mississippi—Pearl Valley Electric Power Assn., Columbia, 223 mi. rural distr. lines, sys. imprvs., Marion Co., **$1,010,000.**

•Mont., Elmo—Bonneville Power Admin., 729 N. E. Oregon St., Portland, 8 Ore., Elmo substation, near here, Inv. No. 4726. Plans deposit $25. L. C. Stewart, 729 N. E. Oregon St., Portland, Zone 8 Ore., ch. engr.

Nebraska—Consumers Public Power Dist., R. L. Schacht, genl. mgr., 1452 25 Ave., Columbus, approx. 70 mi. 115 kv. 3 phase rural distr. line from Kramer to Humboldt, via Beatrice, from point in southwest ¼ of Sect. 12, Twp. 7-N, Range 5 East in Lancaster Co.; approx. 3 mi. east and ½ mi. south of Kramer, then south and east to proposed substation to be located in northwest ¼ of Sect. 28, Twp. 4-N, Range 6 East in Gage Co.; said substation location is approx. 1 mi. north and 1 mi. west of city of Beatrice, then east and south to proposed substation location in SW ¼ of Sec. 35, Twp. 3-N, Range 13 East, Richardson Co.; said location approx. ½ mi. north and 1 mi. east of city of Humboldt. Plans deposit $15. Rural distr. lines from O'Neil to Ainsworth, **$325,000.** R. L. Schacht, c/o owner, ch. engr.

N. Y., New York—Dpt. Wks., Municipal Bldg., Zone 7, general contract, plumbing, electrical work for power plant expan., phase D-Central Plant Bldg., on Welfare Island. Plans deposit $25.

Ohio—U. S. Eng., Madison Ave. and 8 St. W., Huntington 18, W. Va., outside electric lines, Local Protection Proj., Portsmouth-New Boston.

Oklahoma — East Central Oklahoma Electric Co-operative, Okmulgee, 677 mi. rural distr. line and sys. imprvs., Okmul-

HANDY ANDY SAYS:

When you have to plug it... plug it up with

Johns-Manville

DUXSEAL

DUXSEAL—the plastic plugger-upper—can do more work for you with less effort than almost anything you can name. Work-conscious electricians have taken advantage of the effortless application characteristics of Duxseal for years . . . to plug up openings around service boxes, cable entrances, conduit ends . . . to fill up small holes in foundations.

Remains soft—Duxseal stays soft indefinitely, but will not slump, melt or run under ordinary temperatures.

Remains tight—Clings to duct walls and cables but gives with expansion or contraction of the cable.

Remains insoluble—Unaffected by ground waters and gases.

Remains harmless—Will not injure workmen's hands or react with rubber, metals or painted surfaces.

Tight seals for other electrical uses:

J-M Tranolseal . . . for use with electrical equipment using dielectric oils.

J-M Uniseal . . . for caulking against weather and humidity. Resists temperatures up to 180 F.

If you would like to know more about Duxseal and these other labor-saving sealing compounds, write Johns-Manville, Box 290, New York 16, N. Y.

JM

Johns-Manville

SEALING COMPOUNDS

gee Co. **$1,675,000.**

Oregon—U. S. Eng., 19 E. Poplar St., Walla Walla, Wash., design, mfg. testing, and del. seven 56,000 kva. single-phase, 3-winding power transformers and appurtenances for McNary Dam Power plant, Serial No. Eng-46-164-49-110.

South Dakota—E. M. Electric Assoc., Ipswich, 1,214 mi. rural distr. lines and sys. imprvs., Edmunds Co., **$1,995,000.**

Tennessee—Plateau Electric Co-operative, Oneida, 469 mi. rural distr. lines and sys. imprvs., Scott Co., **$1,250,000.**

Texas—Gulf States Utility Co., 362 Liberty St., Beaumont, 85 mi. 132,000 volt electric transmission line between Navasota and Dayton, Grimes Co. **$2,600,000.**

Tex., Fort Worth—Texas Electric Service Co., Electric Bldg., reconstruct electric sub-station in Arlington Heights. **$100,000.**

Wis., Green Bay — Wisconsin Public Service Corp., Bellen Bldg., plans by J. E. Somerville, 403 Walnut St., 2 story, bsmnt., and 1 story dock level 120x300 ft. rein.-con., steel, brick warehouse, office and service bldg., 1 story 140x180 ft. steel brick, garage, concrete fdn., floor, **$1,300,000.**

Wyoming—Hot Springs County Rural Electric Assoc., Thermopolis, 60 mi. rural distr. lines and sys. imprvs. **$325,000.**

Low Bidders & Contracts Awarded

N. M., Albuquerque—U. S. Eng., P. O. Box 1538, June 18, electric power substation, Sandia Base, Serial No. 291-49-100, from Newbery Electric Co. of Arizona, 2142 E. Washington St., Phoenix, Ariz., **$165,077**; special test standby electrical facilities, radio receiving and transmitting bldg., Sandia Base, Serial No. 291-49-105, to Robert E. McKee, P. O. Box 1706, Santa Fe, **$386,532.** Bids 6/24.

South Dakota — Inter-County Electric Assn., Mitchell, 523 mi. rural distr. lines, Davison Co., to Ferguson-Diehl Co., Jefferson, Ia., **$516,627.** Bids 6/23.

Texas—Central Power & Light Co., 120 N. Chaparral St., Corpus Christi, 37 mi. electric power lines into Port Mansfield, **$75,000**; 37 mi. electric power transmission line, at Port Mansfield, **$75,000,** both Willacy Co., force account.

Virginia—U. S. Eng., foot of Front St., Norfolk, Zone 1, two 7,500 kv. and one 750 kva. generators at Philpott Dam, Franklin and Henry Counties, from General Electric Corp., River Rd., Schenectady, N. Y., **$303,930** and **$30,918** respectively.

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Proposed Construction

Colo. Pueblo—Colorado State Hospital, c/o Dr. F. H. Zimmerman, Pueblo, 6 story 80x350 ft., rein.-con. face brick 360 senile patient hospital, $1,250,000; 4 story, rein.-con., face brick 300 female patient hospital, $1,000,000. Bid date changed. W. Gordon Jamieson & R. Ewing Stiffler, 818 12 St., Denver, Earl C. Morris, 518 Empire Bldg., Denver and Walter De Mordaunt, 738 Thatcher Bldg., Pueblo, archts.

Mass., Boston—Commonwealth of Mass., Dpt. P. Health, State House, plans by Curtin & Riley 45 Newbury St., hospital, nurses home and out patient dpt. in Forest Hills, **$12,500,000.**

Pa., Phila.—Douglass Hospital, 50 St. and Woodland Ave., and Penna. State Auth., Harrisburg, plans by George Wharton Pepper, Jr., 225 E. 15 St., hospital. **$3,000,000.**

Low Bidders & Contracts Awarded

Del., Wilmington — John Wanamaker, City Hall Square, Phila., Pa., department store, shopping center, etc. to John McShain, Inc., 17 and Spring Garden Sts., Phila., Pa., Approx. **$5,000,000.** Bids 6/23.

N. M. Los Alamos—U. S. Atomic Energy Com., Los Alamos, June 15, 438 concrete, frame duplex apartments, appurtenances, Serial No. Eng-291-49-134, from Haddock Engineers Ltd., & Assoc., Santa Fe, **$5,805,760.**

Tenn., Nashville—Pub. Bldgs. Admin., 18 and F Sts., N. W. Wash. 25, D. C., 8 story federal bldg., to Beers Constr. Co., 70 Ellis St., N. E. Atlanta, Ga., **$4,584,000.** Bids 3/11.

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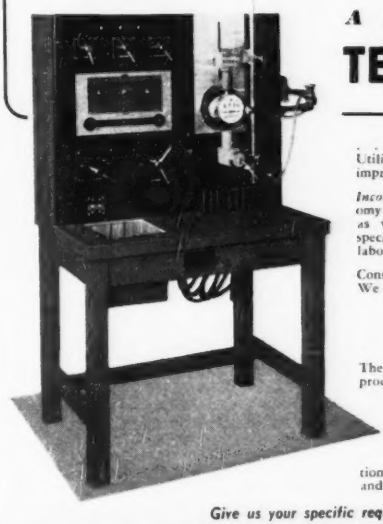

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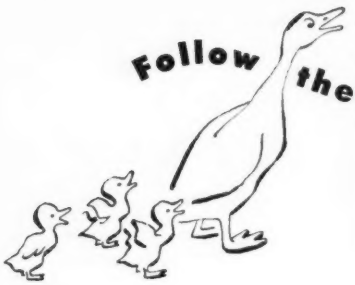

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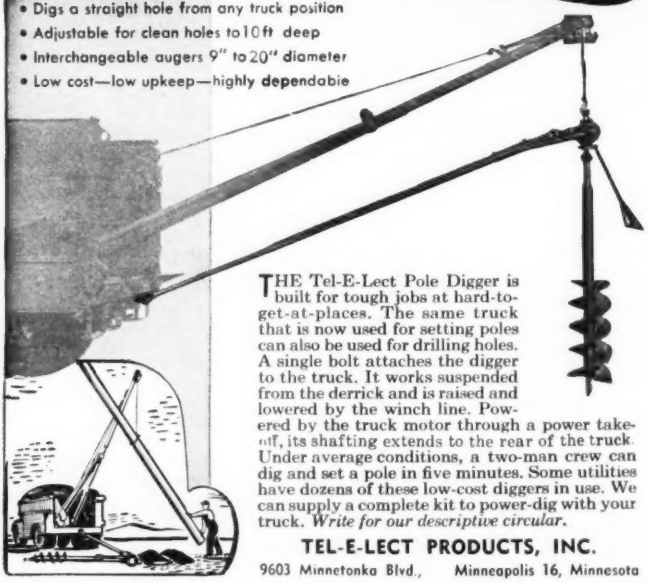

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RECENT RATE CHANGES

Pennsylvania Power & Light Co has filed a substitute rate schedule with the state Public Utility Commission, proposing increases of $2,100,000 instead of the original $2,240,000. The utility asked the commission to vacate its suspension order of the original petition and the Pennsylvania State Grange dropped its complaint against the increase. The commission met to discuss the new petition, but took no action.

Scranton Electric Co, Scranton, has filed a new tariff with the state Public Utility Commission, effective Sept 1, increasing rates an estimated $439,237 annually for 85,103 of 86,351 customers in Lackawanna, Luzerne, Wayne, Susquehanna, Lycoming, and Tioga Counties. The utility's tariff increases from 50 to 75 cents the monthly minimum charge for domestic service and makes upward revisions in commercial and large power service schedules. A fuel adjustment clause, providing for increases or decreases in rates depending on the company's fuel costs, is added to these schedules and applies to the kwhr consumption as follows: Commercial, small power, and commercial lighting services, all use in excess of 400 kwhr per month; large power and capacity power services, all kwhr used.

Tidewater Power Co, Wilmington, N. C., has asked the state Utilities Commission for permission to increase its rates to net the company $319,500 annually, or about 7.5% in annual gross revenue. Public hearing on the utility's application has been set for July 28.

•

ASA Issues New Standard, Signs, Outdoor Displays

A significant addition to the 24 American Standards concerned with building codes is the recently approved American Standard Building Code Requirements for Signs and Outdoor Display Structures, A60.1-1949. It is designed primarily to provide technically sound requirements for the design, erection, and maintenance of signs and structures carrying messages to the public, according to the announcement.

In drafting the standard, the committee did not consider aesthetic or social problems, because such questions are matters for decision by the public itself. Rather, the committee was guided solely by necessity for setting forth requirements that would insure that a sign would be properly supported and anchored so that it would not be blown over in a gale. Some subjects that required extended consideration were heights of signs, allowable wind loads and provisions limiting the use of plastics on signs. The Standard A60.1-1949 is available at 50c a copy from the American Standards Association, 70 E 45 St, New York 17, N. Y.

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TECHNICAL LITERATURE

Turn Ratio Test—Instruction Manual 55-J for use with "TTR" transformer turn ratio test set is made available by James G. Biddle Co, 1316 Arch St, Philadelphia 7, Pa. The 72-page, pocket-size book contains a description of the set, how it is operated, how it can be applied to check ratios of power and distribution transformer as well as to maintenance and winding procedures, points on maintenance of the instrument, and data to assist in tests.

Copper—"Fundamental Characteristics of Revere Metal" gives a basic technology of copper, brass and bronze. Among the topics are copper and its alloys; cold working and hardness; annealing, corrosion, and specifications. Included is a 7-page glossary of metallurgical terms. The 63-page booklet has been issued by Revere Copper and Brass Inc, 6500 East Slauson Ave, Los Angeles, Calif.

Heat-Treating—A concise summary of the subject Flame Hardening is presented in Tempel Topics, Vol 4, issued by Tempil Corp, 132 West 22nd St, New York 11, N. Y.

Hydraulic Standards — "Joint Industry Conference (JIC) Hydraulic Standards for Industrial Equipment," covers hydraulic controls, pumps, piping, fluid passages, fittings, valves, oil reservoirs, diagrams, and includes two pages of symbols. Copies are obtainable by writing Miller Motor Co, 1027 North Kedzie Ave, Chicago 18, Ill.

Electric Heating—Heat requirements for air, liquids and solids, heat lossess from solid surfaces and through insulated walls, instructions for figuring typical jobs, selection of strip, cartridge and immersion type heaters, hot plates, air heaters and heat controls, and product listings are included in a catalogue issued by Industrial Engineering & Equipment Co, 711 South Theresa Ave, St. Louis 3, Mo.

Selenium Rectifiers — Circuit and stack diagrams, current ratings, basic and operating characteristics, and applications in addition to product listings are presented in rectifier catalog VC-3000 available from Vickers Electric Division, Vickers Inc, 1815 Locust St, St. Louis 3, Mo.

Photoelectric Cells—Description, construction, electrical and mechanical characteristics, applications, and appropriate illustrations are contained in catalog VC-4000 on a self-generating photoelectric cells. The 12-page publication can be obtained from Vickers Electric Division, Vickers Inc, 1815 Locust St, St. Louis 3, Mo.

Model Drafts—(1) "Draft of a Ordinance Regulating the Sale of Certain Electrical Equipment," (2) "Draft of a State Law Providing for the Inspection of Electrical Installation" and (3) "Draft of a State Law Regulating the Sale of Certain Electrical Equipment" are presented as a guide in the preparation or adoption of legislation which would make it unlawful to sell certain types of electrical products unless approved for sale and use. Copies are available from National Electrical Manufacturers Association, 155 East 44th St, New York 17, N. Y.

Internal Combustion Engines—"Test Code for Internal Combustion Engines" is a new code designed to meet current requirements for a dependableset of rules for the testing of all types of modern reciprocating internal-combustion engines. Copy at $1.50 each can be obtained from American Society of Mechanical Engineers, 29 West 39th St, New York 18, N. Y.

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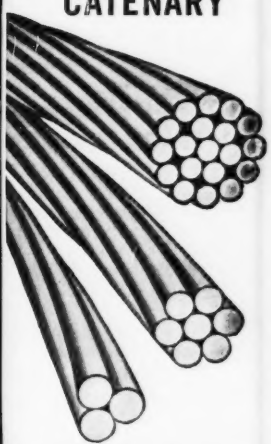

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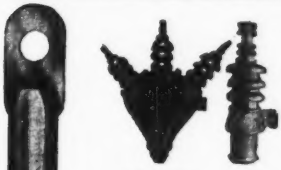

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LETTERS TO THE EDITOR

Diesel Operating Costs

To the Editor of ELECTRICAL WORLD

The Sub-Committee on Oil Engine Power Cost of the Oil and Gas Power Division, ASME is presently conducting its canvass of diesel operating costs among the operators of power plants. This canvass is conducted every year and on the basis of results received, a report is gotten out in the late fall. Such a report has been issued every year since 1928, and the body of data accumulated is considered to be one of the most authoritative in existence on the subject.

Operators who report believe that the copy of the published report which they receive back is of great benefit to them in comparing their own performance with that of comparable plants.

There is no preferred list of plants that are solicited. The Committee adds such plants as it hears of through published notes and other information but is willing and anxious to include the performance of any diesel plant that can report accurately on its output in kilowatt hours and its operating costs. Whether the plant is showing the high or low cost of power has nothing to do with its eligibility. The only index is that of accuracy of information.

While the Committee is known as the Sub-Committee on Oil Engine Power Cost, data received from plants generating power by gas diesels are eligible for publication, as well as data on oil burning diesel engines.

Any diesel plant operator who feels he is able to report his operating cost accurately but who has not received the questionnaire from the committee can secure one by dropping a postcard to the Committee Secretary, Mr. H. C. Lenfest, Continental Engineering Corporation, 30 Church Street, New York.

Any publicity you may be able to give this will be greatly appreciated.

M. J. Reed
Socony Vacuum Oil Co Inc
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Underground Distribution for Residential Area

To the Editor of ELECTRICAL WORLD:

The Weberwood Development Company is currently investigating the advantages and liabilities of obtaining an underground electrical system for the new residential community which it is now developing. In West Virginia there have been very few, if any, underground installations, and hence it is

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difficult to find information and cost data to compare the underground and the overhead. Obviously, the local utility company has had more experience with the pole systems and favors them.

In the June 24, 1944 issue of ELECTRICAL WORLD, there is an article which is a resume of experiences on underground installations. Since this article is now five years old and considerable progress has been made during and following the war in the field of synthetic insulation, we are interested in knowing about the present status of buried lines. We have heard conflicting stories about the relative costs of the systems, and we are trying to collect enough information to make a cost estimate. The property values would unquestionably be greatly enhanced by the elimination of poles, and it would appear reasonable to think that the maintenance on an underground system would be practically nil. In this region of numerous electrical storms, an underground system would be free from this hazard, and the weathering of insulation should be very slight. These facts would seem to make it attractive if the installation cost is not too high.

We felt that your position would bring you into contact with the new developments where underground systems have been installed within the past few years, and we would appreciate any data or information which you can supply. We would also appreciate references to utility companies that have successfully installed residential systems, or other sources that we might contact for advice.

John H. Howell
Weberwood Development Co
So. Charleston, W. Va.

ELECTRICAL WORLD expects shortly to publish a comprehensive report on a system of a type which resembles what Mr. Howell apparently has in mind—Editors

Indoor Airblast Breaker

To the Editor of ELECTRICAL WORLD:

Your article on the Arthur Kill station says that the switching station is believed to constitute the first indoor 34.5-kv air blast circuit breaker installation to be made. Perhaps you mean the first indoor utility station to be made.

For the record, please note that the General Motors assembly plant in St. Louis, a couple of years ago installed a 34.5-kv air blast indoor substation for their power supply.

Fred B. Wipperman
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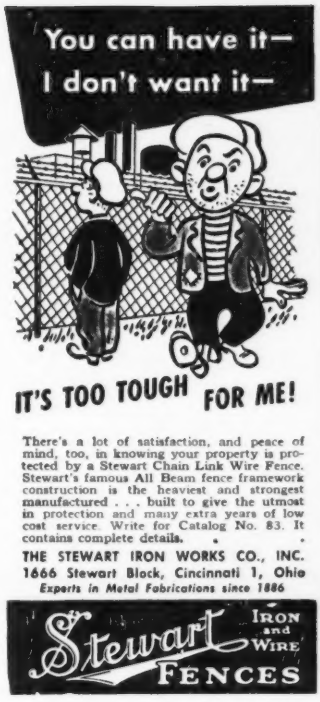

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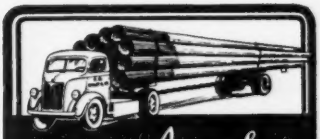

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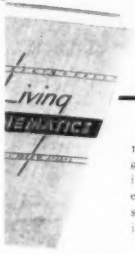

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WRITTEN in a light style, this is just the book for those who never got beyond arithmetic and now wish an introduction to more advanced mathematics in convenient self-study form; and for those whose acquaintance with algebra or trigonometry is slight and wish to review and then proceed to calculus and number theory. Written for the "great battalion of those who fear the subject"—not with the idea of removing their difficulties, but with the hope of adding interest and pleasure to their work.

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POSITIONS VACANT

ENGINEER FOR Georgia Electric Membership Corporation qualified to head department, must be eligible for registration; experienced in distribution, operation and planning both rural and urban construction; under 40 years of age and with initiative. State briefly qualifications and salary expected in first letter. P-9178, Electrical World.

ENGINEERS: FOR professorships all engr. fields. Master's and Doctor's quality unusually fine positions $4500-7000 nine months. Instructors, bachelors. Give phone, photo, qualifications. Cline Teachers Agency, East Lansing, Mich.

SELLING OPPORTUNITY OFFERED

ESTABLISHED LINE of Power and Distribution Transformers, Southeast, New England, and Mid-West territories available. RW-9218, Electrical World.

POSITIONS WANTED

ENGINEER, (GRADUATED electrical-mechanical) 30 years in all branches. Field and office. Consultant, Supervisor, Liaison on large construction projects handling utilities and building construction of communities efficiently. Also survey and reports on Foreign Nations power and industrial exploitation. Anywhere home or abroad. Physically perfect. Age 54 years min. $9000 and up in accordance with location. Highest references possible. Present contract expires September. J. Slingerland, Pleasantville, New York, Phone 2393.

SUPERVISOR 52 years old. 24 years supervisor, operation and maintenance of substations, hydroelectric plants and underground in large utility. Experience in safety and labor relations. Resume on request. PW-9348, Electrical World.

(Continued on the opposite page)

ELECTRICAL and MECHANICAL ENGINEER
with 19 years experience in engineering, wishes to make change. Experience has included electric distribution (overhead and underground), transmission, substations, switchboards, wiring for motors and lights, illumination, traffic signals, heating, air conditioning, water distribution. Now located in San Francisco Bay Area, but will move.
PW-9387, Electrical World
68 Post Street, San Francisco 4, California

ELECTRICAL LINE
WANTED
FOR INDUSTRIAL PLANTS
MANUFACTURER'S REPRESENTATIVE
N. Y. C. & VICINITY

20 years experience in distribution field & application engineering in industrial field. Can promise experienced, aggressive promotion of good line.

RA-9362, Electrical World
330 W. 42 St., New York 18, N. Y.

ELECTRICAL ENGINEER

Opening in Cleveland Office for Supervisory Electrical Engineer experienced in Power Plant Design. Applicant must have experience in engineering calculations and design of generating, switching and distribution systems.

Position offers lengthy employment with good salary to qualified applicant.

Please submit complete resume of experience, education and salary requirement to:

THE H. K. FERGUSON CO.
Engineers and Builders
Ferguson Building
Cleveland 14, Ohio

TURBINE STEAM-ELECTRIC SUPERVISOR

A physically and mentally active turbine Steam-Electric Station Engineer to, under an active superintendent, supervise mechanical (only) operation and maintenance of a medium pressure, medium sized turbine plant. Only one having a wide range of detailed experience with and knowledge of boilers, turbines, condensers, machine shop practice, boiler, piping and general all round maintenance can qualify.

If you are of the "executive" or office type you will not fit in. It is an active "get around and get into things" kind of a job, requiring an intimate, personal background of experience with all phases of mechanical operation and maintenance.

Absolute sobriety, dependability and good character are "musts." If you have the experience and personal characteristics outlined and think $400.00/month, slightly plus, as an ultimate rate is a good figure, write, giving full outline of education, experience and work references. All confidential, of course.

P-9241, Electrical World, 330 W. 42 St., NY 18, NY

WANTED

ESTABLISHED ENGINEERING FIRMS — SALES AGENCIES FOR LARGE DIESEL GENERATING PLANTS

Reputable, established company needs territorial sales agencies. Applicants must be thoroughly reliable, long standing, familiar with municipal, central station, and other power requirements. Write

RW-8597, Electrical World
68 Post St., San Francisco 4, Calif.

Wanted by Manufacturer

Experienced man to handle sales correspondence and quotations on distribution and power transformers. Should have pleasing sales personality, be an electrical engineering graduate, and have actual sales experience.

P-9373, Electrical World
330 W. 42nd St., New York 18, N. Y.

TRANSFORMERS *FOR SALE*

12—1000 KVA G.E. Pri. 2300 to 13200 Sec. 230 to 2300, 1 Ph. 60 Cy.
9—300 KVA West. Pri. 2300 to 13200 Sec. 230 to 2300, 3 Ph. 60 Cy.
3—75 KVA G.E. Pri. 2300 Sec. 230/115, 1 Ph. 60 Cy.
2—150 KVA Eisler Pri. 2300/4600 Sec. 230/460 3 Ph. 60 Cy.
3—150 KVA G.E. Pri. 2300/4000Y Sec. 115/230 1 Ph. 60 Cy.
3—100 KVA G.E. Pri. 6900/11950Y Sec. 230/460 1 Ph. 60 Cy.
1—1000 KVA West. Pri. 2300/13200 Sec. 230/2300 3 Ph. 60 Cy.

PARTIAL LISTING — SEND US YOUR INQUIRIES — WE HAVE IT. TRANSFORMERS BUILT TO YOUR SPECIFICATIONS, REPAIRED AND REWOUND.

BUFFALO TRANSFORMER CO.
1513 Niagara St. - Grant 2716 - Buffalo 13, N. Y.

FOR SALE—NEW
3—Transformers General Electric
500 KVA, Single Phase, 60 Cycle, Primary 13,200V, Secondary 2400V, Catalogue No. 47X347, Type HS-60-500-13200, 780 Gallon, No. 10C, complete with oil. Serial Nos. 8,636,995, -996, -998. These transformers were purchased new in 1948 and never installed.
Equipment located at Mount Morris Dam Site
Mount Morris, New York
For inspection and details contact
MOUNT MORRIS DAM BUILDERS
MOUNT MORRIS, N. Y.
Phone Mount Morris 298

3—G.E. 1 PHASE SELF COOLED
TRANSFORMERS
Rated 333 KVA; Type H; Form K2D; 33000-2400/4160 Y Volts 55 Deg C Rise Impedance 5.25%. Weight each is 5350 lbs. Taps on High Voltage Side for 33825, 33000, 32175, 31350, 30525 Volts with External Tap Changer. Serial Nos. 6416903, 6416904, 6416905.

Village of Skaneateles, Light Dept.
Village Clerk
Skaneateles, New York

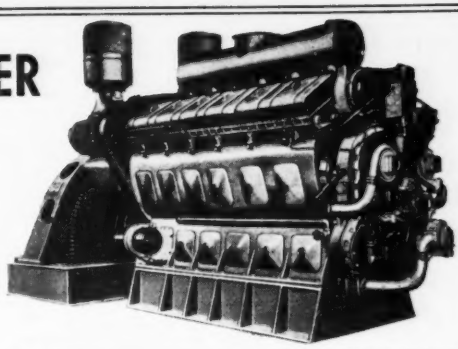
When Answering BOX NUMBERS...
to expedite the handling of your correspondence and avoid confusion, please do not address a single reply to more than one individual box number. Be sure to address separate replies for each advertisement.

DIESEL ELECTRIC POWER

FOR

IMMEDIATE DELIVERY

UNIT CAPACITIES—10 TO 1420 KVA
A. C.—50 AND 60 CYCLES
ANY VOLTAGE



A PARTIAL LIST OF OUR INVENTORY

KVA	Make	Model	HP	RPM	KVA	Make	Model	HP	RPM
1420	Fairbanks Morse	38D8⅛	1600	720	375	Enterprise	DSG-6	450	450
1250	General Motors	16-278A	1600	720	312	General Motors	8-268A	450	1200
1000	General Motors	12-278A	1200	720	187	Ingersoll Rand	S	225	514
900	General Motors	12-567	1100	720	125	General Motors	3-268A	150	1200
625	Alco	6-12½x13	750	600	75	General Motors	6043C	90	1200
425	Baldwin	VO-6	510	450	62	Int'l Harvester	UD-18	76	1200

WRITE FOR COMPLETE INFORMATION

Engineered AGSCO DIESEL POWER

A. G. SCHOONMAKER Company, Inc.

ESTABLISHED 1898

Diesel Engines • Power Machinery

ENGINE DIVISION 50 CHURCH STREET, NEW YORK 7, N. Y.

POSITIONS WANTED

(Continued from opposite page)

EXECUTIVE ACCOUNTANT — Twenty-three years with utility holding and operating companies in an executive capacity. Thorough knowledge of all phases of Federal income taxes including preparation of large consolidated returns, determination of property bases for depreciation purposes, conferences with revenue agents and settlement of taxes at time of audit of returns. Experienced in preparation of registration statements to SEC; in auditing of public utility companies; cost accounting of large construction projects; preparation of budgets and forecasts and installation and revamping of accounting systems. Has ability to handle personnel and supervise those working under him. PW-9295, Electrical World.

ELECTRICAL SUPT., technical graduate engineering background, fifteen years experience mining and heavy industrials. Maintenance and construction all phases, hydroelectric experience. Administrative ability. Age 37, married, desire to change connection. Reference record complete. PW-9368, Electrical World.

GRADUATE ELECTRICAL engineer B.S.E.E., Member of A.I.E.E., married, 25, one year distribution engineering experience, radar experience in Army-M.I.T. Radar School. Desires a position with broad experience and promising future. PW-9354, Electrical World.

U. S. Government

UNITED STATES DEPARTMENT OF THE INTERIOR, Bureau of Reclamation. Sealed bids (Specifications No. 2718) will be received by Bureau of Reclamation, Denver, Colorado, August 16, 1949, and then publicly opened for furnishing radio and carrier-current telemetering apparatus, instruments, and switchboard for the centralized power dispatching system, Davis Power System, Davis Dam Project, Arizona-Nevada. Delivery is desired within 150-450 days. For particulars, address Bureau of Reclamation, Building 1-A, Denver Federal Center, Denver, Colorado.

MICHAEL W. STRAUS, Commissioner. (100)

For Sale

ALL NEW

ELECTRICAL EQUIPMENT

IMMEDIATE DELIVERY

MOTORS

(3 PHASE - 50 CYCLE)

Quan.	HP	Volts	RPM
1	600	3000	600
2	75	220/380	2970
1	60	220/380	2970
2	50	220/380	2970
1	30	220/380	2960
1	25	220/380	1480
2	20	220/380	2960

TRANSFORMERS — PANEL BOARDS

ALSO MANY NEW SPARE PARTS

DULIEN ENTERPRISES, INC.

40 EXCHANGE PLACE NEW YORK 5, NEW YORK

Telephone - Bowling Green 9-4160

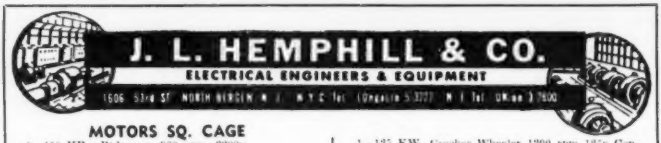
MOTORS, GENERATORS, TRANSFORMERS
1 — 1500 H.P.
Bought and Sold
New and Rebuilt
ELECTRIC EQUIPMENT CO.
ROCHESTER 1, N. Y.

For Sale

Generator Voltage Regulators

General Electric GDA, Westinghouse Silvertat, Allis-Chalmers Rocking Contact, for AC and DC Generators All Sizes Available for Quick Delivery.

Western Regulator Exchange
1730 Wazee St. Denver, Colorado



J. L. HEMPHILL & CO.

ELECTRICAL ENGINEERS & EQUIPMENT

1606 53rd St. NORTH BERGEN, N. J. N. Y. C. Tel. (Regent 5-3777) N. J. Tel. UNion 3-7800

MOTORS SQ. CAGE

1—450 HP.—Ridgeway 900 rpm 2200v.
1—125 HP. G.E., 1800 rpm 2300v.
2—100 HP. Whse. 1800 rpm 440v.
1—100 HP. Whse. 1200 rpm 2200-440v.
1—75 HP. Whse. CS. 1200 rpm. 2200 volts. 3 phase. 60 cycle.
1—75 HP. 1800 rpm Westinghouse. 440 volt.
1—75 HP. General Electric Type KT 900 RPM 440 volt.
2—40 HP. G.E., 900 rpm 220v.
40-20 HP. Westinghouse 600/450 44 volt.

MOTORS SLIP RING

1—2500 HP G.E. MT 257 RPM 6600 volt.
2—150 HP G.E. Type IM 450 RPM 440 volt.
1—100 HP G.E. Type IM 400 RPM 440 volt.
1—100 HP G.E. 720 rpm 440v. 25 cy. IM.
75 HP. G.E. 1200 rpm 220v. 60 cy. Vert.
60 HP. West. 900 rpm 2200v. 60 cy. Vert.
50 HP. F.&M. 1800 rpm 220v. 60 cy.

MOTORS—D. C. 230 VOLTS

1—125 HP. G.E. 1800 rpm R.C.
1—75 HP. 865 rpm General Electric.
1—50 HP. 700 rpm Crocker-Wheeler.

VARIABLE SPEED—220 VOLTS

1—35 HP. 300/1200 rpm Westinghouse.
1—30 HP. 440/1200 rpm General Electric.
2—25 HP. 650/2200 rpm Westinghouse.
2—25 HP. 300/900 rpm Electric Dynamic.
1—35 HP. 500/1500 rpm General Electric.

MOTOR GEN. SETS

1—1000 KW Westinghouse 275 volt, 720 RPM 4000 volt Syn.
1—1000 KW General Electric 600 volt 514 RPM 4000 Volt Syn.
1—500 KW. G.E. 250v 900 rpm 2300v Syn.
1—500 KW. G.E. 575v 900 rpm 2300v Syn.
1—125 KW. Crocker Wheeler 1200 rpm 125v Generator 2200v S.C. Motor.
1—100 KW. Elect. Mach. 1200 rpm 125v Generator 4150 Syn. Motor.

PLATING GENERATORS

1—1½ KW. G.E. 5/6v with sq. cage mt.
1—12 KW. Hansen Van Winkle 24v 1200 rpm. 20 HP. General Electric KF Motor.
1—3000 Amp. Chandeysson, 6-12v 400 rpm Syn. Motor.
1—2500 Amp. ditto.
1—625 KVA West. Reduction Gear Turbo Generator Non-Condensing, 2400v 3 ph 60 cy.

TRANSFORMERS

1—1000 KVA G.E. 3 ph. 4150 volt to 2400 volt.
3—400 KVA G. E. 6900 V. Pri. 2300 V. Sec.
3—300 KVA Pitts. 2300v pri. 115-230v sec.
3—300 KVA G.E. type H. 2300 pri. 115-230v sec.
3—150 KVA West. 2300 volt Pri. 240-480 sec.
1—150 KVA G.E. 2300v 110-220v.
3—100 KVA G.E. 4150v. 240-480v. Pyranol.
3—100 KVA G.E. 4150 v 230-460 v Pyranol.
3—75 KVA Anser. 2400v. pri. 240-480 sec.
6—50 KVA West. 2300 v. 120-240 v. Inerteen.

ALTERNATORS & SYNCH. MOTORS

1—2500 KVA Westinghouse, Syn. condenser, 720 rpm 2200v with D.C. exciter.
1—320 KVA Allis Chalmers, 450 rpm 480v.
1—240 KVA General Electric ATB, 600 rpm 240v with D.C. exciter.
1—225 KVA 514 rpm 600v Westinghouse.
4—200 100 HP. Whse. 720/360 rpm 4150v.
1—200 HP. General Electric 257 RPM 440 volt.
1—100 HP G.E. type TS 600 rpm 4400v D.C.
2—150 HP. Allis Chalmers, 360 RPM, 2200 volt.

Complete Line of A.C. and D.C. Motors and Generators

TRANSFORMERS

FOR SALE

3—500 KVA A-Ch	33000—2300
6—333 KVA G-E	33000—2300/4000Y
3—333 KVA G-E	13800—120/240
6—333 KVA G-E	2400—240/480
2—200 KVA G-E	6900/11950Y—460/230/115
4—150 KVA G-E	22000—2300/4000Y
3—150 KVA G-E	6600—220/440
3—150 KVA W-H	6900—460/230/115
3—150 KVA L-M	2400/4160Y—120/240
5—100 KVA G-E	33000—2300
1—100 KVA G-E	13200—2400
3—100 KVA G-E	11000—2300/4000Y
4—100 KVA G-E	6600—220/440
3—75 KVA W-H	230/460—115/230 DRY
3—50 KVA G-E	33000—2400/4160Y
3—50 KVA Pitts	26400—2300/4000Y
3—50 KVA W-H	4800/8320Y—120/240
6—50 KVA Pitts	2400—120/240
3—37½ KVA Mel	13200—2400/4160Y
6—37½ KVA Mel	13200—120/240
3—37½ KVA W-H	6600—220/440

TRANSFORMERS

WANTED

Reliable rewind and repair service on all makes of transformers.

THE ELECTRIC SERVICE CO.
Cincinnati 27, Ohio

FOR SALE

4000 KW TURBINE GENERATING PLANT

Consisting of

1—2000 KW and 2—1000 KW General Electric, 3 phase, 60 cycle, 480 Volts, 3600 R.P.M. Condensing Turbo Generator Units. Complete with all Auxiliaries. General Electric inspection reports are available.

A. G. SCHOONMAKER CO., INC.

50 CHURCH ST. DIgby 9-4350 NEW YORK 7, N. Y.

TURBO GENERATORS

1—4000 KW G.E. Auto Extraction 250 lbs., 550°F., 25 lbs., ext. surface condenser, 3 ph., 60 cyc., 2400 volts, 3600 RPM
1—5000 KW 6250 KVA, G.E. 3600 RPM 175/200 lbs. I.SP. 100° S.H. Condensing 3 ph. 60 cy 2300/4000v. Surface Cond. & Aux.
1—2000 KW G.E. 6600c, 3 ph., 60 cy. with 175 lb. cond. turbine and dir. conn. exciter
1—1500 KW G.E. 2300v., 3 ph., 60 cy. with G.E. 225 lbs. cond. turbine, surface condenser
2—750 K.W G.E. condensing, 3600 250 lbs. Surface condenser, 3 ph. 60 cyc. 440v. dir. conn. exciters
1—300 K.W. G.E. non-condensing 175 lbs., 5/15 lbs. B.P. 3 ph., 60 cyc., 480 v. Dir. conn. exciter
1—1000 KW. G.E. 2300/4150v, 3 ph., 60 cy. with 135/150 lb. condensing turbine

BELYEA COMPANY INC.
51 Howell St. Jersey City 6, N. J.
Phone—Journal Square 2-3334
ALSO N. Y. CITY LINE—RECTOR 2-7150

DIESEL GENERATOR PLANTS

COMPLETE WITH SWITCHBOARDS
1000 KW TO 100 KW
STATIONARY AND PORTABLE
AT GREATLY REDUCED PRICES
NEW UNIT GUARANTEE

HERCULES ELECTRIC MACHINERY and EQUIPMENT CO.

Telephone NEvada 6-2808 1412 So. Alameda Street
Cable Address HEMCOY Compton 1, Calif.

Power Equipment

Released by Utilities & Industrials

Turbines, Generators, Steam and Oil Engines, Boilers, Motor Generators, Rotaries, Transformers, Motors, Compressors, Induction Voltage Regulators, Oil Circuit Breakers, etc.

Service backed by 40 years' experience

BREW, WOLTMAN & CO.

52 Church St., New York 7, N. Y.

TO HELP YOU

Sell Equipment You No Longer Need Use

"Searchlight" Advertising

"SUCCESSFUL OPERATION GUARANTEED" *Belyea*

We Rebuild in accordance with N.I.S.A. Standards

D. C. MOTORS

Qu.	HP	Make	Type	Volts	Speed
1	2000	Whse.		600	600/720
1	1750	Whse.		600	550/700
2	1000	Whse.		525	600
1	1200	Whse.		600	525/700
1	700	G.E.	MCF	600	150/525
1	650	G.E.	MPC	250	115/145
1	600	Whse.		600	800/950
2	600	G.E.	MPC	600	600/720
1	385	Whse.	MQ	250	300/900
1	200/300	G.E.	MPC	220	360/920
1	275	Whse.	QM-600.6	230	425/850
1	250	G.E.	MPC	230	400/800
1	230	Al. Ch.		230	700
3	150	Whse.	SK-200	230	600
1	150	Cr. Wh.	CMC-65H	230	1150
1	150	G.E.	MPC	230	230/450
1	150	Cr. Wh.	152HL	230	300/1050
3	150	Cr. Wh.	TEFC-87H	230	890
1	150	G.E.	CD-B-Brg.	600	250/750
2	125	G.E.	CO	270	625
1	125	El. Dy.	308	230	750/1560
1	115	Cr. Wh.	JHL	230	1200
1	100	G.E.	CD-175	230	365/730
1	100	G.E.	MPC	230	225/450
3	100	Whse.	SK-Vert.	230	485/950
2	100	Rel.	1050T	230	400/1200
1	80	El. Dy.	308	230	475/950
1	75	Cr. Wh.	53H-TEFC	230	860
1	75	Whse.	SK-180	125	650
2	75	G.E.	CDM-4126Y	230	2000

TURBO GENERATOR SETS

See ad on page 581

SYNCHRONOUS CONDENSERS

Qu	KVA	Make	Type	Volts	Speed
1	5140	Wh e		4160	600
1	4000	G E	TSC	2400/4150	900
1	3000	Whse.		2400	720

MOTOR GENERATOR SETS

3 Ph. 60 Cycle

Qu	KW	Make	Speed	DC Volts	AC Volts
1	2000(30)	Whse.	720	600	2300
1	1500	G.E.	360	275	2200/4400
1	1500	G.E.	600	600	4150
1	1500	Whse.	600	600	4150
1	1250	G.E.	600	275	2300/4150
1	1000	Cr. Wh.	720	250	2300/4150
1	1000	Whse.	514	250	4000
1	1000	Whse.	720	600	2300/4150
1	1000	Whse.	900	600	2300/4150
1	800	3UGE	1200	240	2300
1	500	G.E.	720	125	2300/4150
1	500	G.E.	720	600	4400
1	750	Whse.	720	275	2300/4150
1	400	G.E.	720	250	440/2300
1	400	G.E.	1200	120/240	440
1	350	G.E.	900	125	4150
1	300	G.E.	1200	120/240	440
1	250	Whse.	1200	240	440
1	150	Cr. Wh.	1200	250	220/440
1	140	Cr. Wh.	720	125/250	2200

ROTARY CONVERTERS (60 cycle)

Qu.	KW	Make	Speed	DC Volts	AC Volts
1	2000	G.E.	514	600	13200
1	2000	G.E	450	600	13200
1	1000	Whse.	900	600	11000
1	750	Whse.	900	600	13200
1	500	Whse.	900	250	6600

All units can be furnished with AC and DC Control

MERCURY ARC RECTIFIERS

1	1000	Al. Chal.	B-612	625	13500
•1	1000	B-B	25/60 cy	625	6600/13200
1	750	G E.	RHW	575	2300/4000

•Complete with full automatic A.C. and D.C. controls.

A. C. MOTORS—3 Ph. 60 Cycle

Synchronous

Qu.	HP	Make	Type	Volts	Speed
2	3200	G.E.	TS	2300	257
1	2100	G.E.	ATI	4600	514
2	2000	Whse.		2200	120
1	1470	Whse.		2300/4600	900
1	1000	Whse.	MILL	2300	189.5
2	900	Al. Ch	Eng (new)	2200	150
1	600	Whse.		440	300
1	500	G.E.	ATI	480	900
2	500	G.E.	TS-9832	4160	600
1	450	Whse.		2200	128.5
2	350	G.E.	TS	2300	150
1	329	G.E.	ATI	2300	600
1	308	Al. Ch.		440	600
1	300	G.E.	ATI	440	720
1	300	Whse.	Enc.	2300	720

Slip Ring

1	1000	Whse.	CW	2300	705
2	700	Whse.	CW	2200	900
1	600	G.E.	MT	440	720
1	500	G.E.	IP	550	505
3	450	G.E.	IM	440	505
1	500	G.E.	Mill-IM	2200	450
2	350	Whse.	CW	2200	900
1	350	G.E.	MT-442y	4000/23	257
1	300	Al. Ch.	ANY	2300	505
3	300	Al. Ch.	ANY	2300	705
1	250	G.E.	MT	4000	257
1	250	G.E.	MT-559S	2200	750
1	135	G.E.	IM	2300	700
4	125	G.E.	MT-566Y	2300	435

Squirrel Cage

1	250	G.E.	KT-556	440	1750
1	200	G.E.	KT-557	440	1800
1	200	G.E.	IK	550	865
1	150 .50	Whse.	CS	440	79/843
1	125	(new) G.E.	KF TEFC	440	1190
1	125	G.E.	KF-6328L	440	3588
2	100	G.E.	KT-543	220/440	1750

Every Machine Is Owned Outright by Us

RE NU BILT — BELYEA — MOTORS

Belyea COMPANY, INC.

MAIN OFFICE AND SHOP
51 HOWELL ST., JERSEY CITY, N. J.

What are your needs?
UNITS UP TO 5000 KW
AVAILABLE IN STOCK

JOSEPH P. MANYPENNY COMPANY

SWITCHGEAR AND SAFETY DEVICE ENGINEERS

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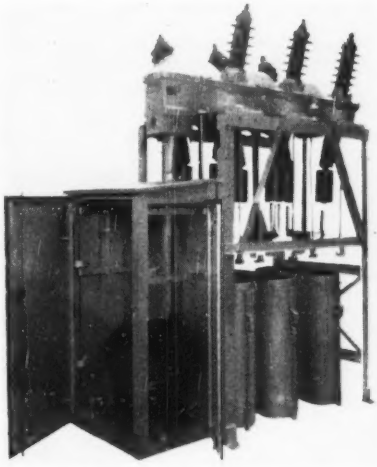

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1	Al. Chal.	BZO-60-115-F	600	115	1500
1	Al. Chal.	BZO-60-115-D	600	115	1000
1	Gen. El.	FKO-139-42-B	600	73	1000
1	Gen. El.	FKO-236-2452-F73	400	73	500
2	Gen. El.	FKO-136-2046-BS	400	50	280
2	Condit.	FO-40-37-C	400	37	750
3	West.	G-11	400	37	175
1	Gen. El.	FKO-339	2000	25	500
1	Gen. El.	FHKO-236-1640-B	1200	25	250
5	Gen. El.	FKO-136-1328-A	400	25	125
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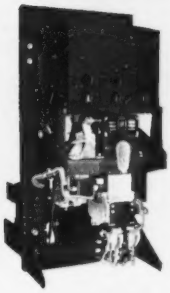
The *extra quality* built into I-T-E Air Breakers



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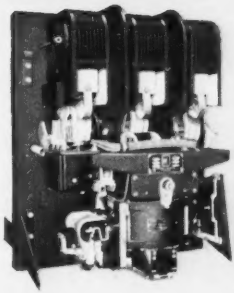

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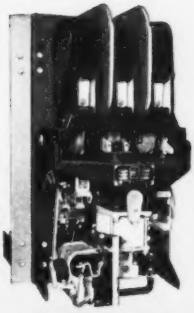
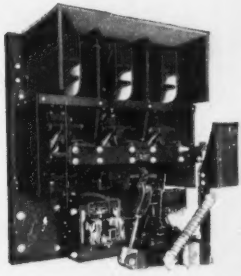


25,000 RMS Amp. Interrupting Rating. 600 Amp. Continuous Rating. 2, 3, or 4 Poles. Manually or electrically operated.



TYPE AD

100,000 RMS Amp. Interrupting Rating. 6000 Amp. Continuous Rating. 2, 3, and 4 Poles. Electrically operated.

makes I-T-E Multumite your *best Switchgear buy!*

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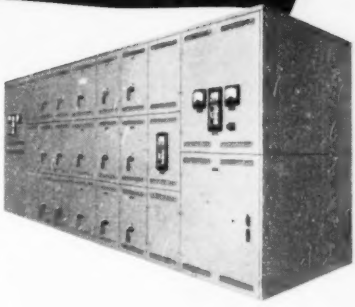

ASK THE I-T-E REPRESENTATIVE *for complete information on low voltage I-T-E Air Circuit Breakers and Switchgear units. There is an I-T-E representative in your locality. All I-T-E Representatives are switchgear specialists—fully qualified to advise and assist you in planning or improving your distribution system. Use their services without obligation.*

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KUHLMAN FACT FILE
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NO. 2 OF A SERIES

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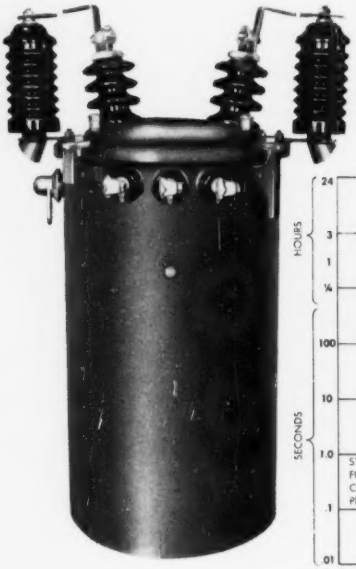
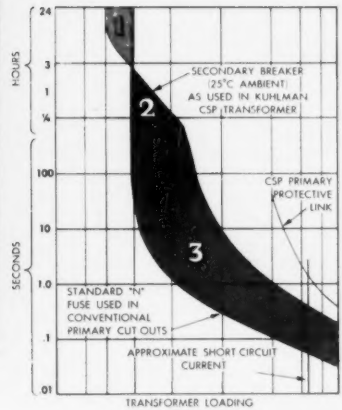


5 KVA. Single Phase, 60 Cycle, Form 2, Class A, CSP, 2 cover bushing, 7200—120/240.



A Kuhlman CSP transformer is a "package" unit—breakers, lightning arresters and internal protective links are built in before transformer is mounted on the pole. This means lower initial cost for you plus greater overload protection for your transformers and customers! The graph above demonstrates how CSP protection works by comparing load-time trip curve of a typical Kuhlman CSP transformer with the load clearing curve of a primary cut-out fuse. These curves cross to create three zones:

1. Red—Danger Zone. Conventional cut-out fuses permit dangerous overloads which might burn out transformer insulation.
2. Black—Load Loss Zone. CSP breaker safely permits overloads that would be dropped by cut-out fuse with resultant customer service interruption.
3. Grey—Service Continuity Zone. CSP breaker safely permits transient overloads caused by motor starting, swinging arcs, etc., that would be dropped by cut-out fuse and interrupt customer service.

The breaker curve automatically shifts to left or right as ambient temperatures rise or fall, assuring safe temperature loading summer and winter. Cut-outs can't do this. And, any trouble not cleared by the secondary breaker melts the internal primary protective link, removing the transformer from the line.

Thousands of completely self-contained, self-protecting Kuhlman CSP transformers are supplying urban and rural areas everywhere with efficient, trouble-free service. Why not get the full facts on them today?

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TRANSFORMER TOPICS by KUHLMAN

QUESTION: How are voltage ratings of Single Phase transformer windings designated?

ANSWER: In order to specify transformers for various methods of installation commonly used, a nomenclature, involving a group of symbols, has been developed by transformer users and manufacturers. This nomenclature covers both the high-voltage and low-voltage ratings.

By industry standard all single-phase transformers, having high voltage windings rated between 600 and 8660 volts, are suitable for either wye or delta operation. In the case of the 2400 volt transformer, this is expressed by the following convention 2400/4160Y. This same convention applies above 8660 volts, but only those so designated are suitable for the wye connection. For instance, a transformer designated by 66,000 volts is suitable for 66,000 volts delta only. If designated 66000/114000Y, the transformer is suitable for 66000 delta or 114000Y. A third designation, 66000/Grd Y indicates that the transformer has reduced insulation at one terminal and is only suitable for use on a wye system with a solidly grounded neutral, 66000 being the wye voltage.

Single phase transformers with one fully insulated terminal and with the other grounded to the tank for service on a grounded wye system, or, on a single phase system with one line solidly grounded, are designated by the wye voltage followed by a Grd Y, slant, and the phase voltage, as follows: 12470 Grd Y/7200.

The slant is also used to differentiate the newly-established voltage rating of 14400 with taps at 13800, 13200, 12870 and 12540. This rating is specified as 14400/13200 to differentiate it from the 14400 volt rating with taps at 14100, 13800, 13500, and 13200.

In low-voltage nomenclature (600 volts and below) the principle that must be most clearly specified is whether the transformer is suitable for series and parallel operation only, or, whether it is suitable for three-wire service as well. A transformer is suitable for three-wire service if full load may be developed from the series connection, or, if half-load may be developed from either half of the winding connected in series.

The symbols used to specify this usage are the slant (/) and the (X). When the slant is used with the half voltage preceding the full voltage in the 0-600 volt class, it indicates that the winding is suitable for series, parallel, and three-wire operation. 120/240 means that the full capacity of the winding may be developed with the winding in parallel at 120 volts, with the winding in series at 240 volts, or, that the winding may be connected in series with the midpoint brought out and each of the 120 volt windings (to the midpoint) will develop one-half the rated capacity.

If the rating were written 240/120 the winding would develop full capacity at 240 volts, and each of the 120 volts would develop half capacity. No provision is made under this rating for parallel operation at 120 volts.

The X is used to designate series-parallel windings which develop full capacity on either the series or the parallel connection. It is used in both high and low voltage ratings. These ratings are not suitable for three-wire operation. 120 x 240 indicates that the winding will develop full capacity at 120 volts parallel or 240 volts series but is not suitable for three-wire service.

In the case of the 2400 x 4800 high voltage rating, the X is used with the same significance.

When these symbols are used in the specified manner, no confusion should exist concerning the suitability of a transformer for operation on a given system voltage.

For reference refer to NEMA Standards for Transformers Pub. No. 48-132 Pages 41-42-43.

Designation of voltage ratings for three phase transformers will appear in a subsequent issue of Transformer Topics.